

High Energy Astrophysics Program

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October 1, 1995 through March 31, 1996



by

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Task Activities under Contract NAS5-32490 during the Period of
October 01, 1995 through March 31, 1996
(individual project reports are attached on the indicated pages listed by task number)

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University Space Research Association Goddard Visiting Scientist Program Employee
name: Lorella Angelini Task Number: 5030-01A-39

Software Development and maintenance : XRONOS and XIMAGE

The migration of the core XRONOS programs from XANADU to FTOOLS is now completed. The FTOOLS version of XRONOS (version 5) has been distributed with the FTOOLS release of March 1996. I have designed and directly contributed to all the structural and cosmetic changes of the software, in how the data are assembled, in how the algorithms are applied, in extensive testing and in writing the documentation. At this efforts worked under my supervision a programmer (Larry Brown). The tasks of XRONOS 5 now use the same parameters interface as all the other FTOOLS tasks and IRAF compatible. The multiseries tasks for the lightcurves (lc1, lc2, lc3) and folding (ef1, ef2, and ef3) has been combined in two tasks lcurve and efold with the capability to analyze simultaneously up to 4 time series. The plotting is now directly called by each single task rather than a spawning process. The input and output are only in FITS and for compatability with the XRONOS 4. I have implemented a separate task to reformat data from old input XRONOS format to FITS. The memory allocation is now handled at run time rather than using static allocation arrays. In the next period I have planned to update documentation on the Web side and to further implement additional timing tasks.

XIMAGE changes: 1- number of levels and their values can be input from an ASCII input file and save the levels. 2- the events file reader now only require an X and Y columns, 3- the GTI are not longer require, 4- implement a new psf normalization. XIMAGE bugs fixes: 1- images filtered by time calculate the right exposure, 2- vignetting correction applied properly to ASCA data, 3- labels in color bar display now is fixes for display, 3-psf .

EXOSAT The second CD is under production and it will be distributed at the AAS meeting in June. This CD contains all the lightcurves, spectra taken with the ME, GS, LE and TGS instruments on board EXOSAT in 3 years operations. The CD will contain data in FITS but also gif files will be available for each observation made. I have written scripts to generate the gif files for spectra and lightcurve for all the experiments (ME, GS, TGS, CMA1 and CMA2). The gif files for all GS (spectra and lightcurves) , CMA1 and CMA2 (lightcurves) are completed. The ME spectra and lightcurves are about to be completed. I am also coordinating the technical (B. Perry) and graphics (K. Smale) part for the final production.

The effort of the data restoration in FITS for the EXOSAT raw data will resume after the CD is finished.

SAX I am currently the local contact for the SAX SDC (Science Data Center). I have put on-line the SAX CORE program proposal list, accessible via browse or the W3BROWSE. I have been consulted regarding their software implementation, particularly about the possibility to use for SAX also the second generation of XSELECT, and distributing their software under FTOOLS.

WGACAT catalog: The lightcurve and spectra for each WGACAT REV1 source (for a total of 98326) are now all availbale from the HEASARC FTP area. For each source the following products are available: a fits lightcurve, spectrum and arf, a gif lightcurve and spectrum.

We are preparing for run a REV2 of the catalog when all the ROSAT PSPC will be available in the archive.

FITS Format: I have been reviewing FITS file format for the GINGA LAC and SAX MECS and LECS instruments. In both cases I have checked compatability with other files from different missions and tested compatability with HEASARC software.

Community Service: I have been reviewing papers from Ap. J. Letters and A.&A.

Working Papers and Proposal:

- *The ROSAT variable sky*, Angelini, White, Giommi. A sample of variable stars was obtained using the 'timing' imaging technique applied to all the sequence processed for the WGA catalog. After an accurate screening of all sources with a $\chi^2 > 50$, sample now consists in 320 sources. For each source a lightcurve and spectra during the flare was obtained. All the spectra were systematically fitted with four basic spectral models. Most of those sources are not optically identified. The main aim of the project is collecting all the common X-ray characteristics to infer possible optical counterparts. We published the first results on a subsample in the conference Proceedings of "Röntgenstrahlung from the Universe".
 - *The Nature of the 6-s and related X-ray pulsars: evolutionary and dynamical considerations* Ghosh, P., Angelini L. and White N. to be submitted 1996. Recently it has been suggested that a group of 5 pulsars, all having a period around 6 seconds, are possible descendent of a Thorne-Żytkov object. The paper investigates under this assumption the type of accretion flow on the neutron star to explain the soft nature of the X-ray spectra. We have used this argument to explain the emission in 4U0142+61 (see published paper).
 - *ASCA Observation of the Big Dipper*. I analyzed the ASCA data of the Big Dipper, to study both spectral and temporal characteristics. Using together ASCA and EXOSAT data I was able to construct a model for the X-ray emission of this source. However the nature of the compact object still is unclear since shares properties common to either BH candidate system as well as neutron star system. I am currently working on a paper and I will present the results at the "Accretion phenomena" meeting (Port Douglas July 1996).
 - *ASCA Observation of GX1+4*, Pravdo, Angelini, Day. I have studied the timing characteristics of the ASCA data for GX 1+4 and the results were correlated to the BATSE data. The ASCA observation is a key observation because occurs just before the change from spin-down to spin-up detected with BATSE.
 - *The Black hole candidate 4U1630-47*, Parmar, Angelini, White. We are working on a second paper on the outburst recurrence of 4U1630-47 which will include archival data from Ginga LAC, Einstein HRI and MIR-TTM.
 - *SAX Core program proposals* I have contributed to seven SAX proposals for the SAX CORE program due in November 1995. The CORE program time is 80% of the time satellite the first year and the PI must be part of the SAX institute consortium (Italy, Netherlands and Germany). I collaborated with the ESTEC/ESA group (Netherlands) and the TESRE group (Italy). Five 5 proposals were approved (the review for the CORE time was in January).
- I have also collaborated at two proposals for the GO time due March 1996.

Published Paper and IAUs:

- *HD 49798 AND 2E 0050.1-7247*, IAU 6277, Israel G., Stella L., Angelini L., White N., Giommi P., On the discovery of pulsation of two sources detected in the WGA catalog.
- *4U 1608-52*, IAU 6331, Marshall F., Angelini L., XTE team. On the discovery of 4U 1608-52 in outburst with XTE.
- *Periodic Outbursts from the Black Hole Candidates 4U1630-47*, Parmar A.N., Angelini, L., White, N.E. 1996, in "Röntgenstrahlung from the Universe", eds H.U. Zimmermann, J.E. Trumper, H. Yorke, in press.
- *The Rosat variable sky*, Angelini L., Giommi P., White, N.E., 1996 in "Röntgenstrahlung from the Universe", eds H.U. Zimmermann, J.E. Trumper, H. Yorke, in press.
- *The Spectrum of the 8.7s Pulsar 4U0142+61*, White, N., Angelini, L., Ebisawa, K., Tanaka, Y., Ghosh, P., Ap.J. Letters in press.

Dr. M. F. Corcoran

Activity: 5030-02A-39

Semi-Annual Technical report, 1 Oct. 1995 - 31 Mar 1996

9 Apr. 1996

PROGRAMMATIC ACTIVITIES ACCOMPLISHED

1) ROSAT Public Data Archive

a) The mechanism for release and ingest of ROSAT data into the ROSAT Data Archive was entirely revamped. I wrote new software which almost entirely automates all steps in the data transfer process including retrieval of public datasets from the data center, verification of transferred data and ingest into the HEASARC jukebox and creation of BROWSE data table updates. This software has been tested and used successfully since Jan 1. In addition, I wrote, tested and implemented new software to handle transfer and ingest of reprocessed ROSAT data.

b) I helped the RSDC design a new means of data staging which speeds up transfer of data to the HEASARC and NDADS archives and also allows for easier creation of data tapes for exchange with MPE.

c) In this period 267 US ROSAT datasets and 353 German/UK ROSAT data sets were released to the archive. Most of this release took place after Jan 1 1996 due to implementation of new data transfer software. In this period 240 REV0/1 datasets were replaced by reprocessed REV2 datasets.

d) the ROSAT archive data lists have been updated to reflect recent ingests.

e) Number of e-mail communications during this period: 757, including user comments, data release and archive maintenance communications.

2) ROSAT Results Archive

a) I released the production version of the HRI screening software (hvi2.5.5). The production version of the PSPC software created by T. Boller (MPE) was also released, and was installed at GSFC.

b) RRA data screening began at the US, German, and UK data centers in Dec. 1995. 822 data sets have been screened at the US sites (GSFC and SAO).

c) I continue to maintain the RRA Web page at GSFC (<ftp://heasarc.gsfc.nasa.gov/rosat/data/qsrc/www/RRA.html>). This page contains the RRA User Guide, software information and results of dispersion testing at the different screening sites, among other links.

f) Number of e-mail communications during this period concerning Results Archive matters: 467

3) Rationalized FITS development for ROSAT

a) RDF software is being ported to the Alpha workstation by M. Good. I'm providing some assistance in this effort.

4) RGOF/HEASARC duties

- a) The RGOF continued its series of bi-weekly meetings
- b) number of e-mail communications regarding RGOF issues: approximately 718, including user questions and internal RGOF problems.
- c) I produced the 5th volume of ROSAT images on CDROM (with B. Perry and K. Smale). These CDROMS were distributed at the Jan AAS meeting in San Antonio.
- d) I provided RGOF support to M. Smith during this period.

SCIENCE ACTIVITIES

- 1) I've taken the lead in organizing a "large project" of X-ray observations of OB and WR stars using ROSAT and ASCA.
- 2) I'm providing up-to-date X-ray observations of Eta Carinae as part of a multi-wavelength monitoring campaign

TRAVEL

- 1) I attended the X-ray meeting in Wurzburg in Oct. and presented a poster on recent X-ray observations of Eta Car.
- 2) I attended a workshop on colliding winds in binary stars in Argentina in November, and gave an invited talk on X-ray emission from colliding winds.

PAPERS

PUBLISHED:

"X-ray Variability in V444 Cygni - Evidence for Colliding Winds?", M. F. Corcoran, I. R. Stevens, A. M. T. Pollock, J. H. Swank, S.N. Shore, and G. L. Rawley, 1996, ApJ, in press.

"Eta Carinae: Variability in a New Light", M. F. Corcoran, G. L. Rawley, J. H. Swank, R. Petre, and J. H. M. M. Schmitt, 1996, in "Roentgenstrahlung from the Universe", in press.

"X-ray Emission From Colliding Wind Binaries", M. F. Corcoran, 1996, RMAA Conf. Ser., in press.

SUBMITTED:

"ASCA Observations of Gamma2 Velorum (WC8+O9I): The Variable X-ray Spectrum of Colliding Winds", I. R. Stevens, M. F. Corcoran, A. J. Willis, A. M. T. Pollock, S. L. Skinner, F. Nagase, and K. Koyama, MNRAS.

PROPOSALS SUBMITTED/AWARDED

I was PI on an accepted ASCA AO4 proposal to observe Eta Car (\$14K awarded)

I was PI on an accepted ASCA AO4 proposal to observe Gam2 Vel (\$16K awarded)

I'm Co-I on a proposal to observe Eta Car with SAX (Viotti PI)

PLANNED ACTIVITIES

- 1) Continue screening of data and population of ROSAT Results Archive and creation/population of source catalogue.**
- 2) Continue supervision of ROSAT Public Archive including ingest of WG data and ingest of REV2 data (the final archive product).**
- 3) Continue guest observer support activities**
- 4) Publish results of analysis of ROSAT observations of Sco OB1 and Cyg OB2 and ASCA observations of Gamma Vel, HD 153919 and Zeta Ori**
- 5) Continue monitoring X-ray emission from Eta Car.**

SEMI-ANNUAL TECHNICAL REPORT FROM DR. STEPHEN A. DRAKE

CODE 660.2/LHEA:HEASARC RESEARCH SCIENTIST

1995 October 01 - 1996 March 31

WORK ACCOMPLISHED AND IN PROGRESS

(i) Science Related

- Guest Investigator Proposal Status

The ASCA AO-4 Guest Investigator proposals were reviewed and I and my collaborators did quite well: of the 3 proposals that I wrote as Principal Investigator (PI), 2 were successful (one conditionally), while of the 7 other proposals I was a Co-Investigator (Co-I) on, 5 were awarded time.

- Scientific Meetings

I attended the 9th Cambridge Cool Stars Workshop in Florence, Italy from October 3-6, 1995, and presented a poster paper entitled 'An Analysis of the ASCA Spectra of the Active Giants Beta Ceti and Capella Using the New MEKAL Coronal Plasma Code'. I subsequently wrote a contributed paper on this subject that will be published in the workshop proceedings.

I attended and gave a review talk entitled 'X-Ray Measurements of Coronal Abundances' at the 6th Annual Maryland Astrophysics Conference: Cosmic Abundances that was held in College Park, Md from October 9-11, 1995. I subsequently wrote a review paper on this subject that will be published in the conference proceedings.

- Scientific Publications

In addition to the above two conference papers, I assisted as co-author in writing two other conference papers which were lead-authored by K.P. Singh (Senior NRC Fellow on leave from TIFR, India). The status of other papers of which I was lead-author or co-author are as follows:

(a) 'Corona(e) of AR Lac: I. The Temperature and Abundance Distribution', by K.P. Singh, N.E. White (NASA/GFSC), and myself, was published in the January 10, 1996 issue of ApJ.

(b) 'Corona(e) of AR Lac: II. The Spatial Structure', by M. Siarkowski (Space Research Center, Wroclaw, Poland), P. Pres (Wroclaw University), myself, N.E. White, and K.P. Singh, was resubmitted to ApJ on March 22, 1996, after a new set of calculations by the first two authors and a major rewrite by myself. This followed the receipt of a rather critical referee's report on September 5, 1995.

(c) 'RS CVn versus Algol-type Binaries: A Comparative Study of their X-Ray Emission', by K.P. Singh, myself, and N.E. White, was accepted for publication by AJ. It is presently scheduled for publication in the June 1996 issue.

(d) 'The X-Ray Evidence that the 51 Peg Companion is a Planet', by S. Pravdo (JPL), N.E. White, L. Angelini (USRA), myself, and R.A. Stern (LPARL), was submitted initially to Nature, and subsequently to New Astronomy. A critical referee's report was received from the latter, and the paper is presently being revised.

(e) 'ROSAT Observations of Five Chromospherically Active Stars', by K.P. Singh, myself, N.E. White, and T. Simon (U. Hawaii), was accepted for publication by AJ. It is presently scheduled for publication in the July 1996 issue.

(f) 'Emission Measure Analysis Methods: The Corona of AR Lac Revisited', by J.S. Kaastra and R. Mewe (SRON, Holland), D.A. Liedahl (LLNL), K.P. Singh, N.E. White, and myself, was accepted (contingent on a few small revisions) by A&A.

(g) 'X-Ray Spectra of Late-Type Dwarfs: Speedy Mic and YY Gem', by K.P. Singh, myself, E.V. Gotthelf (USRA), and N.E. White, was commenced, and a first draft written. This paper should be submitted to ApJ in May 1996.

- Refereeing Duties

In November 1995 I reviewed 32 proposals submitted to the National Radio Astronomy Observatory (NRAO) for observing time on its facilities, and e-mailed my scores and comments back to NRAO on November 10. This completes my 2-year service as an NRAO referee.

- Other Science Activities

In December 1995, I, assisted by S. Humphrey (HSTX), created a new online version of the Strassmeier Active Binaries Catalog which included much enhanced X-ray and radio data (provided mostly by myself), as well as other improvements. This database has already been used to provide input to one of my papers (Pravdo et al. above), and will be made public eventually.

I participated in 2 meetings of the joint GSFC/SAO et al. NGXO/LAXSM Concepts Project on December 15, 1995 (at GSFC) and on March 6, 1996 (at SAO), as well as several meetings of the GSFC Next Generation X-Ray Observatory (NGXO) team.

The VLA proposal to obtain simultaneous radio data for 2 stars (Algol and HR 1099) for which we have confirmed XTE and, in the case of Algol, also ASCA observing time was successful. I prepared 4 OBSERVE files for the VLA program to observe Algol that were executed in early February, 1996.

(ii) Programmatic

I continued to monitor the WWW, anonymous ftp and Gopher services provided by the HEASARC to the scientific community. We are presently transferring data via ftp, http, and Gopher utilities at a rate of about 20 Gigabytes per month, while our data archive has reached a size of about 400 Gigabytes.

I continued to work closely with our BROWSE database creators Pat Tyler and Susan Humphrey to ensure quality control of the final product. The following 14 new databases and catalogs were made public in the period covered by this report:

Name	Description	Observatory	Updated
ASCAO	Proposals	ASCA	96.045
ASCAPUBLIC	Archival Data	ASCA	96.080
COSBMAPS	COS-B Map Product Catalog	COS-B	95.360
COSBRAW	COS-B Photon Events Catalog	COS-B	95.318
CRABTIME	Crab Pulsar Timing	CATALOG	95.338
EUV	EUVE Master Catalog	EUVE	95.348
ROSATLOG	Observation Log	ROSAT	96.078
ROSDISTRIB	Distributed Data	ROSAT	96.059
ROSSTL	Short-term Timeline	ROSAT	96.058
ROSPUBLIC	Archival Data	ROSAT	96.058
SAS2MAPS	SAS-2 Map Product Catalog	SAS-2	96.031
SAS2RAW	SAS-2 Photon Events Catalog	SAS-2	96.031
SAXAO	Approved Pointings	SAX	96.043
XTEAO	Proposals	XTE	95.349

I continued to research the status of the gamma-ray burst dataset obtained by the Ulysses GBD instrumenet (PI: Kevin Hurley, UC Berkeley). After not hearing from either Dr. Hurley or the NDDSC contact person for these data, I contacted the latter. He re-initiated contact with the instrument team and the corrected data are expected to arrive at GSFC by May 1996.

I co-ordinated the installation of the TOPBASE atomic physics database on one of the HEASARC's computers which was initiated by Dr. A Pradhan (OSU). Due to the illness of the main technical person, this activity was delayed by several months. It is expected that TOPBASE will be made available as a HEASARC service in May 1996.

(iii) Educational

I volunteered as a helper at Rosemary Hills Primary School's Annual Science Day on January 22, 1996.

I joined the LHEA Outreach Group (OXPOG) and attended one meeting in March 1996. I was assigned the task of preparing a list of the most frequently asked questions (FAQ's).

NON-LOCAL TRAVEL

1. To Cool Stars Workshop in Florence, Italy in October 1995 (see above).
2. To NGXO/LAXSM Coordination Meeting in Cambridge, MA in March 1996 (see above)

WORK PLANNED FOR NEXT SIX MONTHS

I will continue my research into the coronae of stars using hard X-ray, soft X-ray, extreme-ultraviolet, and radio observations as probes of their physical environments.

I will continue overseeing the anonymous ftp account on HEASARC's LEGACY computer, as well as the HEASARC's ADS node, and the request@legacy user hotline. I will continue monitoring our creation of BROWSE and W3BROWSE databases and catalogs.

I will co-ordinate the installation of the TOPBASE database of atomic database on our computers and its being made available to the external user community via a captive account and/or a WWW interface. This database will be a copy of the one installed at CDS in Strasburg, France, and will make it much easier for US users to access these important data.

UNIVERSITIES SPACE RESEARCH ASSOCIATION HIGH ENERGY ASTROPHYSICS PROGRAM

SEMI-ANNUAL TECHNICAL REPORT 1995 Oct 01 - 1996 Mar 31

Employee Name: Ian M George

Activity: 5030-01A-39

1 Programatic Activities

1.1 CALDB Infrastructure & Access

Maintenance & development of the HEASARC *Calibration Database* (CALDB) has continued. A new programmer, Lorraine Breedon (HSTX), started work in late 1995 Sept and has been partially assigned to CALDB-related software development. Over the last 6 months, Lorraine has been learning the CALDB infrastructure and software suite, and has started to contribute CALDB software. Unfortunately however, the CALDB software development has recently taken yet another hit in the departure of Rehana Yusaf (HSTX) in 1996 Mar. Whilst formerly a member of the ROSAT software team, Rehana contributed a large number of software tasks & subroutines with the caltools package and callib library. A replacement has been found (via HSTX) and is scheduled to start in late 1996 Mar, through it is unlikely they will be assigned to caltools/callib work.

Datasets & documentation continue to be delivered to the CALDB by the various instrument teams and GOFs of current mission, as well as by HEASARC personnel (including myself) responsible for the restoration/conversion of data from old missions. With the successful launch of XTE in 1995 Dec, a substantial fraction of the latest files are associated with that mission. The entire database has remained on-line throughout the quarter via the `legacy.gsfc.nasa.gov` computer, and available world-wide via anonymous ftp, WWW etc. The number of files taken from the database per month continues to be rather erratic, reflecting the erratic delivery of new files.

The project to make the installation and maintenance of the CALDB as easy as possible at remote sites has stalled slightly over the last 6 months due to the change of personel (departure of Zellar; arrival of Breedon) and other demands on my time. Nevertheless, it remains top priority and I hope to be able to jump-start it again in the near future.

1.2 Software

Work has continued to develop calibration software tasks under the FTOOLS umbrella. Within the most recent FTOOLS distribution (v3.5; scheduled for release in 1996 Apr), I contributed the following new task:

- `ftools/caltools/caldbinfo` - Checks whether a local CALDB is correctly installed for a user, providing installation instructions if not

I continued maintenance of tasks previously delivered by myself, and have taken over maintenance/development for the large number of tasks formerly the responsibility of Zeller, and a handful of tasks formerly the responsibility of Yusaf.

I also supervised OGIP programmers (Yusaf, Mitra, Breedon) and members of the XTE GOF (Lochner) in the design and writing of several other tasks

1.3 FITS File Formats

I continued to serve as the secretary of the HEASARC FITS working Group (HFWG), maintaining the HFWG-related ftp and WWW areas within the HEASARC's on-line service. However, the HFWG itself has not met within the last 6 months.

2 Personal Research Activities

2.1 Scientific Research

During this reporting-period, a number of research projects were completed, due primarily to fruitful collaborations with Nandra (NASA/GSFC, NRC) and Turner (USRA).

In collaboration with Gondek & Zdziarski (Warsaw, Poland), Johnson (NRL), McNaron-Brown (George Mason Univ) and Gruber (UCSD), a paper discussing an analysis of archival observations of a number of Seyfert-1s made by the *EXOSAT*, *Ginga*, *HEAO-1* & *CGRO* missions has been submitted for publication. We find that the average spectrum of radio-quiet Seyfert-1s above ~ 2 keV is well-fitted by a power-law continuum, with a Compton-reflection hump above ~ 20 keV, absorption at the lowest energies by ionized material, and a high energy cut-off at ~ 100 keV. These findings are discussed in the light of current theoretical models and compared to those obtained for radio-loud Seyfert-1s.

In collaboration with Turner & Yaqoob (USRA), Kallman (NASA/GSFC) and Zycki (Warsaw, Poland), a paper reporting the results from an *ASCA* observations of the Seyfert-1 Mkn 290 has been submitted for publication. The source is found to have a complex spectral form, with emission and absorption features due to oxygen and iron superimposed on an underlying power-law

continuum, and to exhibit significant flux-correlated spectral variability. The relatively strong spectral features observed in this source make it an interesting case to use for an investigation of models for reprocessing of the X-ray continuum by ionized material. We considered ionized reprocessors based upon the XSTAR photoionization code, for geometries in and out of the line-of-sight. We found both a warm absorber/emitter and an ionized reflector model to provide an adequate description of the data, but we concluded a hybrid model (featuring reprocessing in both the warm absorber/emitter and reflector) was likely to be the most physically realistic scenario.

In collaboration with Turner (USRA), Mushotzky (NASA/GSFC) and Nandra (NASA/GSFC; NRC), a paper reporting the results from *ROSAT* & *ASCA* observation of Centaurus A has been submitted for publication. In this paper we present a spectral-spatial deconvolution of this complex source, discussing the X-ray spectrum and variability of the AGN nucleus itself, the knots in the X-ray/radio jet as well as the diffuse X-ray emission from the host galaxy.

In collaboration with Nandra (NASA/GSFC; NRC), Mushotzky (NASA/GSFC) and Turner & Yaqoob (USRA), the first two of a series of papers based on archival *ASCA* datasets have been submitted for publication. These first two papers deal with a uniform analysis of a sample of 23 observations of 18 Seyfert-1 galaxies made during the PV & AO-1 phases of the mission. In the first paper we present details of our data analysis techniques, the spatial properties of the sources (all point-like with no nearby sources likely to contaminate our temporal & spectral analysis) and then go on to quantify the variability characteristics of the individual sources and the sample as a whole. We find that there is a strong anti-correlation between the amplitude of variability and the luminosity of the source. Clear evidence for spectral variability is detected in a number of cases whereby the amplitude of variability in the soft X-ray band is greater than that in the hard X-ray band. The second paper concentrates on the properties of the iron *K*-shell fluorescent line present in all the sources. We find that there is strong evidence that the line is broadened in a large number of cases. In most cases the width of the line corresponds to velocities $\sim 0.1c$, which we interpret in terms of the relativistic effects very close to the supermassive black hole thought to be the ultimate powerhouse of Seyfert galaxies. A number of so-called disk-line models are compared to the data and the theoretical implications briefly discussed. Work is currently underway on a number of other papers related to this project dealing with both other aspects of the Seyfert-1 sample and other classes of AGN.

2.2 Proposal News

The results of several proposal evaluations were made public during this reporting-period. Happily, the following proposals for which I was Principle Investigator were awarded observing time:

1. ASCA AO-4
X-ray Observations of Optically-Selected Quasars (\$15500 awarded)
2. ASCA AO-4
Warm Absorbers in Quasars (\$16700 awarded)
3. ASCA AO-4
The Location of the Warm Absorber in NGC 3783 (\$20300 awarded)

A number of other proposals for which I was a co-Investigator were also successful.

2.3 Other Scientific Activities

As a Co-Investigator on the *Next Generation X-ray Observatory (NGXO)* New Mission Concepts (PI: White, NASA/GSFC) work has continued on the Phase-A study improving the design. Negotiations are now fairly well advanced to merge the NGXO mission concept with that funded for a similar Phase-A study (known as LAXSM) proposed by Tannanbaum (CfA/SAO). A number of meetings between the NGXO & LAXSM design teams have taken place, and an integrated mission concept is emerging. My contribution is primarily in helping to anticipate and define the scientific goals for a mission scheduled for launch in approx 10 years time.

2.4 Papers Published/Accepted

(in the 6 months ending 1996 Mar 31)

(NOTE: Due to the long turn-around time taken for papers submitted to refereed journals, most of the following scientific papers will have appeared in earlier annual & semi-annual reports as submitted/not accepted papers.)

2.4.1 Refereed Journals

1. **Evidence for a Highly Ionized Iron Emission Line in the QSO PG 1116+215**
Nandra, K., George, I.M., Turner, T.J., Fukazawa, Y.
1996, ApJ, in press
2. **Complex Absorption in the Seyfert-1 Galaxy EXO 055620-3820.2**
Turner, T.J., Netzer, H., George, I.M.,
1996, ApJ, in press
3. **The X-ray Spectrum of the BL Lac Object EXO 055625-3838.6**
George, I.M., Turner, T.J.,
1996, ApJ, in press

2.4.2 Non-Refereed Journals, Conference Proceedings etc:

None

2.4.3 Other Articles

None

2.5 Papers Submitted, not yet accepted by Refereed Journals (in the 6 months ending 1996 Mar 31)

1. **ASCA observations of Seyfert-1 galaxies: II. Relativistic Iron K α emission**
Nandra, K., George, I.M., Mushotzky, R.F., Turner, T.J., Yaqoob, T.
1996, ApJ, submitted
2. **ASCA observations of Seyfert-1 galaxies: I. Data Analysis, Imaging and Timing**
Nandra, K., George, I.M., Mushotzky, R.F., Turner, T.J., Yaqoob, T.
1996, ApJ, submitted
3. **Deconvolution of the X-ray Emission and Absorption Components in Centaurus A**
Turner, T.J., George, I.M., Mushotzky, R.F., Nandra, K.,
1996, ApJ, submitted
4. **Reprocessing Models and the ASCA Spectrum of Mkn 290**
Turner, T.J., George, I.M., Kallman, T., Yaqoob, T., Zycski, P.T.
1996, ApJ, submitted
5. **The Average X-ray and Gamma-ray Spectra of Seyfert 1s**
Gondek, D., Zdziarski, A.A., Johnson, W.N., George, I.M., McNaron-Brown, K., Gruber, D.E.
1996, MNRAS, submitted

3 Non-Local Travel

NGXO-LAXSM Integrated Mission Concept Meeting (Boston) 1996 Mar 06

This was one of a series of one day meeting between the Phase-A study teams for the NGXO and LAXSM New Mission Concepts with the goal of merging the two projects into a single integrated mission (see 2.3 above). At this meeting I made a presentation discussing what I considered the major scientific goals of the mission should be in the field of AGN research, along with simulations of the spectral data which could be expected from the current instrumentation design.

X-ray Imaging & Spectroscopy of Cosmic Hot Plasma Conf (Tokyo, Japan) 1996 Mar 11-14

This conference was naturally dominated by results from *ASCA*. At the meeting I presented a poster paper outlining recent results obtained in collaboration with Nandra, Mushotzky, Turner & Yaqoob for the sample of 18 Seyfert-1s discussed above.

4 Work Planned for the period 1996 Apr 01 – 1996 Sep 30

Below are the major activities pending my attention and scheduled to be worked on (though not necessarily completed) in the next 6 months:

- CALDB infrastructure/design *etc*
 - ensure the installation and maintenance of a CALDB at a remote site is as straightforward as possible (which will most likely entail a significant amount of platform-specific scripting).
 - a large number of CALDB-related documents and on-line information sources (eg ftp, WWW) require review and up-dating.
- Software design, development and delivery:
 - *ftools/exosat/mermg* - a response matrix generator for the *EXOSATME* instrument (to be adapted from the XANADU VIMAT package)
- FITS file formats & the HFWG
 - continued review & development of file formats
 - continued maintenance of HFWG ftp & WWW pages
- Archival Data Restoration
conversion to FITS format of the following datasets:
 - *EXOSAT* CMA PHA files and response matrices
 - *EXOSAT* TGS PHA files and response matrices
 - *Einstein* OGS PHA files and response matrices
 - *HEAO-1* A-2 PHA files and response matrices
- Personal Scientific Research
 - continued scientific analysis and publication of recently obtained *ROSAT*, *ASCA* and *IUE* and *XTE* datasets

Technical report: T. McGlynn

Research Activities:

- Continued study of gamma-ray outburst from NRAO 190.
- Continued study of gamma-ray emission from clusters of galaxies.

SkyView Virtual Telescope:

- Several new surveys were included in SkyView including the Compton GRO/COMPTEL all-sky survey, the ROSAT WFC all-sky surveys, and the COBE DIRBE all-sky survey.
- Capability of handling 3 dimensional data.
- Integration of SkyView with HEASARC catalog browser.
- Average daily usage of SkyView is now ~500 images produced per day.

HEASARC archives and catalogs:

- Coordinated activities with government, STX and USRA personnel with regard to HEASARC archive and catalog developments.
- Began full integration of Compton GRO catalogs within HEASARC. GRO observation catalog made available at HEASARC.
- Helped in development of Argus observation tracking system.
- In cooperation with government and STX personnel developed schedule for future archive and catalog activities.
- Developed software to transform HEASARC catalogs to J2000 coordinates.

WorldWideWeb Development:

- Participated in Astrobrowse workshop to develop common astronomy interfaces to all astronomy archives.
- Developed Astrobrowse interface to HEASARC.
- Developed prototype Web Java applications, including a prototype Java interface to SkyView.

- Coordinated HEASARC planning for use of Java applications.
- Developed common library of HEASARC PERL applications.

XTE:

- Developed preliminary XTE archive.
- Coordinated response to SOC processing of IOC data including development of interim archive and catalog.
- Coordinated HEASARC and code 630 development of XTE archive.
- Designed and supervised development of XTE ASM quicklook data archive which will (when ASM data is available) give a daily picture of the X-ray sky.
- Coordinated activities of government, USRA and STX staff in development of XTE archive within the HEASARC.

Dr. Steven L. Snowden
USRA Semi-Annual Technical Report
Task Number: 5030-02A-39
1 October 1995 - 31 March 1996

9 April 1996

Code 662, Laboratory for High Energy Astrophysics
ROSAT Guest Observer Facility

Programmatic Work

ESAS - ROSAT Extended Source Analysis Software

I've continued the task of maintaining and answering GO questions about this software package. I continue to add functionality and to improve the documentation.

TREND Data Analysis

The TREND data processing continues in production mode and is caught up with all available data both from SASS processing and reprocessing. It took a major hit last November when the software for the calculation of Earth's magnetic field needed to be updated. The previous TREND software ran in the IDL environment and proved to be too difficult to update. I modified a previous program that I had written (and which the IDL code was based on) to produce complete TREND data files. A side benefit to this upgrade is that the reduction runs five times faster. At present, 1197 days have been processed.

PSPC Spectral Calibration

Ian George, Jane Turner, and myself have continued to make progress in the spectral calibration of the PSPC. Ftools have been written (and are now being tested) to correct all known errors in the SASS processing and temporal nonlinearities. A paper on the temporal nonlinearity of the gain has been accepted for publication in A&A (Prieto, Hasinger, & Snowden).

Scientific Work

A March trip to Australia to collect 21 cm data (HI column density information) on the SMC was reasonably successful with two thirds of the field being covered. A major purpose of the trip was to gain experience using a radio telescope.

I continue organizing a monthly seminar where the graduate students associated with the lab present progress reports on their work. This seminar seems to be working well with a reasonably good turn out by lab personnel. The graduate students are getting experience in presenting their work and the lab gets to hear what they are doing. It has also been used as a forum for one graduate student to give her thesis defense to a test audience.

Public Outreach

I am a member of the HEASARC Public Outreach group and have been participating in the creation of the WWW education pages. I've also helped the media center director of Clemens Crossing Elementary School with information on the Teacher Resource Center of the GSFC Visitors Center.

Travel

One trip to Australia to observe the Small Magellanic Cloud.

Plans for the Next Half Year

The focus of the next half year will again be on the spectral calibration of the PSPC. Trend processing will continue but with a smaller time commitment. The preparation of documentation for the ROSAT project will also continue but at a reduced level.

Proposal writing and proposal reviews will also take considerable time. I have received ADP proposals for technical review. I will write at least one ROSAT proposal and will provide technical support for the ROSAT Peer review. I will also attend the ROSAT International Users Committee meeting at MPE in July.

I will attend the HEAD meeting in San Diego in May, the AAS meeting in Madison in June where I will give an invited talk, the ROSAT Peer review at Tyson's corner in July, and the ROSAT International Users Committee meeting at MPE also in July.

Scientifically, I have several papers on which I hope to make progress and I will work on the reprocessing of the ROSAT survey data.

6 Month Report for October 1 1995 - March 31 1995

T. Jane Turner
task number: 93-02-00

Meetings:

March 11-14 attended the symposium in Tokyo "X-ray Imaging & Spectroscopy of Cosmic Hot Plasmas"

Presented a talk entitled
"ASCA observations of Seyfert 1 Galaxies"

Which detailed recent advances in understanding the 3-10 keV spectra of Seyfert galaxies, with particular emphasis of the properties of the iron K-shell emission line.

Work In Progress:

Analysis of ASCA observations of Seyfert 2 galaxies.

We are conducting a systematic analysis of a sample of ~20 Seyfert 2 galaxies from the ASCA archives. We intend to use the sample results to obtain an overview of the 0.4-10 keV timing and spectral properties of the class.
(Turner, George, Nandra, Yaqoob, Mushotzky)

An XTE Observation of NGC 3783

NGC 3783 has been observed by XTE, we are analyzing the XTE data with the primary scientific goal of confirming or disproving the presence of the hypothesized Compton Reflection hump. At this early stage of the mission, alot of work is required in order to understand the instrument background, before our scientific goals can be achieved.
(George, Nandra, Turner)

"ASCA observations of Seyfert 1 galaxies: III Warm Absorbers"

We investigate the 0.6-5 keV spectra of Seyfert galaxies in the context of warm absorber, partial covering (absorption) and multi-component continuum models.
(I.M. George, K. Nandra, R.F. Mushotzky, T.J. Turner, T. Yaqoob)

Discovery of Rapid Variability of the Iron K Line Profile in the Seyfert Galaxy NGC 7314

We present rapid X-ray variability of the shape of the iron K line profile in NGC 7314.
(Yaqoob, Serlemitsos, Turner, George, Nandra)

Analysis of ROSAT observations of serendipitous AGN

We have identified ~20 new Seyferts/QSOs discovered as serendipitous X-ray sources in pointed ROSAT PSPC fields. We examine the properties of such soft X-ray selected AGN versus AGN selected by other methods.

(Jones, Turner, Perlman, Malkan, Sharf, George, Nandra)

Papers Submitted

"Deconvolution of the X-ray Emission and Absorption Components in Centaurus A"

T.J. Turner, I.M. George, R.F. Mushotzky, K. Nandra

Submitted to ApJ on March 5th

"Reprocessing Models and the ASCA Spectrum of Mkn 290"

T.J. Turner, I.M. George, T. Kallman, T. Yaqoob, P.T. Zycki

Submitted to ApJ January 29 1996

"ASCA observations of Seyfert 1 galaxies: I. Data Analysis, Imaging and Timing"

K. Nandra, I.M. George, R.F. Mushotzky, T.J. Turner, T. Yaqoob

Submitted to ApJ March 25 1996

"ASCA observations of Seyfert 1 galaxies: II. Iron Ka emission"

K. Nandra, I.M. George, R.F. Mushotzky, T.J. Turner, T. Yaqoob

Submitted to ApJ March 18 1996

Papers Published/Accepted

(in the 6 months ending 1995 Sept. 30)

(NOTE: Due to the long turn-around time taken for papers submitted to refereed journals, most of the following scientific papers will have appeared in earlier annual & semi-annual reports as submitted/not accepted papers.)

Complex Absorption in the Seyfert-1 Galaxy EXO 055620-3820.2,
Turner, T.J., Netzer, H., George, I.M., 1996. ApJ, in press.

Evidence for a Highly Ionized Iron Emission Line in the QSO PG 1116+215,
Nandra, K., George, I.M., Turner, T.J., Fukazawa, Y., 1996. ApJ, in press.

The X-ray Spectrum of the BL Lac Object EXO 055625-3838.6,
George, I.M., Turner, T.J., 1996. ApJ, in press.

Project Support

I have worked on development and testing of code for some new tools scheduled for release March 31 1996. New ROSAT tools include a new version of the PI channel correction tool 'PCPICOR' which has 2 new subroutines added to allow correction for time and energy dependant shifts in the PI data. A new tool, 'extrpsf' has been developed (with the new programmer Banashree Seifert, and with Ian George), to allow extraction of a radial profile directly from events file to FITS radial profile.

Myself and Steve Snowden aim to demonstrate the effect of these corrections to the science results, at the forthcoming HEAD meeting. We are also developing a new response matrix for use with the corrected data. Dr Snowden and I have also reworked the ROSAT Images part of the ROSAT www page, to include more and updated images, all of which are now appropriately captioned.

I have continued working with visiting Guest Observers and at the moment handle ~ 2 email queries per day on ROSAT issues. A significant amount of time is spent answering email and phone queries on data analysis issues and software problems.

Work Planned for the Next 6 Months

We will analyze the ASCA observation of the Narrow Emission Line Galaxy NGC526A

We will continue to work on the new AGN discovered by ROSAT

We will continue to work on systematic analysis of AGN from the PV and AO1 phases of the ASCA mission (now public data).

Technical Report for the period from Oct. 1995 to March 1995

Ken Ebisawa, code 660.2, ASCA GOF

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PROJECT WORK

- # Helped planning ASCA observations of US guest observers.
- # Answered questions from US ASCA guest observers regarding ASCA data analysis and calibration.
- # With other members of the ASCA GOF, developed the ASCA GOF mosaic page, which is accessible through WWW.
- # Participated in the ASCA AO4 review on November 14-15, 1995 as technical advisors.
- # Worked on the following FTOOLS for ASCA data analysis which have been released/to be released soon; addarf, ghkcurve, fexpcor.
- # Participated in the ASCA calibration meeting on Dec. 6 at ISAS, Japan.
- # Participated in the following Astro-E relate meetings:
 - Dec. 7-8, 1995 at ISAS, Japan.
 - Dec. 25, 1995 at Nagoya, Japan.
 - Feb. 10, 1996 at GSFC.
 - March 15-16, at ISAS, Japan.
- # Working on two new ASCA analysis tools;
 - 1) GIS background reproduction tool extracting point sources from blank sky fields.
 - 2) SIS pile-up correction tool.

SCIENTIFIC RESEARCH

- # Got an acceptance letter of three ASCA AO4 proposals submitted in the last semi-annual period.
- # The paper submitted to PASJ in the last semi-annual period, 'On the spectral slopes of hard x-ray emission from black hole candidates' was accepted and published. This is a collaboration with Lev Titarchuk and Sandip Chakrabarti.
- # Submitted the paper 'ASCA Observations of the Iron Line Structure in Cyg X-1' to ApJ, and it was accepted.
This is a collaboration with Drs. Y. Ueda, H. Inoue, T. Tanaka and N. White.

- # Submitted the paper, "X-ray Spectroscopy of Cen X-3 with ASCA over an Eclipse" to PASJ.
- # Working with Y. Ueda et al. on the ASCA GRO1655-40 data taken in 1994. We are writing up a paper to submit.
- # Working with N. Zhang et al. on the ASCA GRO1655-40 data taken in 1995. We are writing up a paper to submit.
- # Visited Marshall Space Flight Center for Nov. 2-3, 1995, and gave a seminar with the title 'Observations of Black Hole Candidates- a standard view and extraordinary ones -'.
- # Participated in the Aspen conference 'Black Hole Transients Novae', for Jan 22-27, 1996, at Aspen Co, and gave a review talk titled 'Observations of Black Hole Candidates with Ginga and ASCA'.
- # Participated in the Super-soft Source workshop at MPE, Garching, Germany for Feb. 28 Mar 1, 1996, and presented a paper titled 'ASCA Observation of the Super-soft Source RXJ 0925.7-4758'.
- # Participated in the 'X-ray Imaging and Spectroscopy of Cosmic Hot Plasmas' meeting at Tokyo for March 11-14, 1996, and presented a review paper with the title 'ASCA Observations of Binary X-ray Sources'.

//////////

WORK PLAN IN THE NEXT 6 MONTHS

- # write following programs/tools for ASCA data analysis.
 - binary orbital motion correction tool,
 - SIS pile-up correction tool,
 - GIS blank sky background production tool.
 - PSF production tool based on ray-tracing.
- # submit the ASCA RXJ0925.7-475 paper.
- # submit a paper on the data analysis of ASCA GRS1915+15 and GRO1655-40 observations.
- # Analyze ROSAT HRI Crab data taken on March 1995 with Mr. Saito at Tokyo Univ.
- # Submit GRO and XTE proposals on Galactic Black Hole Candidates.
- # Participate in the "X-rays and gamma-rays from accreting black holes", meeting at Koninki, Poland, 10-14 June 1996.

Technical Report 1995 October 1 - 1996 March 31
Koji Mukai (Task number: 93-03-00)

0. Immigration status:

I have applied, and been approved, for a green card,

1. ASCA Matters:

We have continued our routine ASCA GOF activities (answering e-mail questions, assisting GOs with their observation planning); we have not had many GOs visiting the GOF over the last 6 months. We also had 4 major, non-routine activities over this period: (1) the AO-4 proposal review (1995 Nov. 14-16); (2) an ASCA calibration workshop at ISAS (1995 Dec. 6-7); (3) updating the technical appendix for the forthcoming release of ASCA AO-5 NRA (1996 Feb. & Mar); (4) programming, supervising of programmers, and testing of ASCA FTOOLS for version 3.5 which has just been released.

Most of the above activities were shared among the ASCA GOF scientists. However, as my responsibility within the GOF is to be the local SIS expert, I have fielded the majority of SIS related questions from GOs and updated the SIS related chapters of the technical appendix. Moreover, we have made a major upgrade of SIS FTOOLS for version 3.5 using latest calibration information, which took a large fraction of my time particularly in February, 1996.

2. Future missions:

I have started to get involved in LHEA activities for future missions.

(1) ASTRO-E, the next Japanese X-ray astronomy satellite to be launched in February, 2000, in which LHEA has software as well as hardware involvement. I have participated in a 1 day meeting in Japan on 1995 Dec. 8 to kick off the US/Japanese software coordination work, and a 2 day science working group meeting (1996 Mar 15 & 16) to review the current status of the mission.

(2) NGXO, a mission concept under study for the years after AXAF, XMM, and ASTRO-E. I have contributed in the discussion leading to the definition of science goals and necessary instrument capabilities.

3. Research activities:

Although I have been analyzing (mostly ASCA) data in between my duties, this was not a very productive periods in terms of finished papers myself (there have been progress on papers by others that I'm collaborating on). I have presented papers at the San Antonio AAS meeting and ASCA symposium in Japan on the ASCA observation of FO Aqr.

4. Projection of future activities:

I will be attending the HEAD meeting in San Diego, where I will be participating in an ASCA data analysis workshop, as well as presenting an invited talk on cataclysmic variables.

The ASCA AO-5 NRA will be released; we will plan the details of Rev 2 processing of ASCA data; an ASCA Users Group meeting will be held; last but not least, a NASA senior review will be held which will determine the future funding level for the ASCA GOF.

ASTRO-E software work will start up in earnest.

I hope to finish, and submit, 2 (or possibly more) papers to ApJ or similar journals.

**SEMI-ANNUAL REPORT TO USRA FOR THE PERIOD
1st October 1995 – 31st March 1996**

Tahir Yaqoob

Activity Nos. 5030-15A-39 and 5030-03A-39
EMPLOYEE ID: 05-05 96800

Papers Published

The following papers were published in this period.

- (i) The Hard X-ray Emission of NGC 3628 and the Contribution of Low-Luminosity Spiral Galaxies to the Cosmic X-ray Background (Yaqoob *et al.*). *Astrophysical Journal*, 455, 508.
- (ii) The Iron K_{α} Line Profile in NGC 4151 (Yaqoob *et al.*). *Astrophysical Journal*, 453, L81.
- (iii) An ASCA X-ray Spectrum of a Prototype Bare Seyfert 1 Nucleus in MCG-2-58-22 (Weaver *et al.*). *Astrophysical Journal*, 451, 147.
- (iv) X-ray Reprocessing By a Molecular Torus in the Seyfert 1.9 Galaxy NGC 2992 (Weaver *et al.*). *Astrophysical Journal*, 458, 160.
- (v) The Nature of the Low-Luminosity AGN in NGC 3147 (Ptak *et al.*). *Astrophysical Journal*, 459, 542.

Papers Accepted

- (i) *Multiwaveband Observations of Short Time-Scale Variability in NGC 4151. I. Ultraviolet Observations*, (Crenshaw *et al.*). *Astrophysical Journal*.
- (ii) *Multiwaveband Observations of Short Time-Scale Variability in NGC 4151. III. X-ray and Gamma-ray Observations*, (Warwick, R. S. *et al.*). *Astrophysical Journal*.
- (iii) *Multiwaveband Observations of Short Time-Scale Variability in NGC 4151. IV. Analysis of Multiwavelength Continuum Variability*, (Edelson, *et al.*). *Astrophysical Journal*.
- (iv) *ASCA Observations of Seyfert Galaxies: II. Iron Line Emission*, (Nandra *et al.*). *Astrophysical Journal*.
- (v) *The X-ray Variability of MKN 766*, (Leighly *et al.*). *Astrophysical Journal*.

Papers Submitted (Not Yet Accepted)

- (i) *ASCA Observations of Seyfert Galaxies: I. Data Analysis, Imaging and Timing*, (Nandra et al.). *Astrophysical Journal*.
- (ii) *Reprocessing Models and the ASCA Spectrum of MKN 290*, (Turner et al.). *Astrophysical Journal*.

Work In Progress

Other research projects worked on during this period are listed below.

- (i) *X-ray Transmission in Cold Matter: Nonrelativistic Corrections For Compton Scattering*, (Yaqoob et al.).
- (ii) *Search For Rapid Iron Line Variability in NGC 7314*, (Yaqoob et al.).
- (iii) *Iron K_{α} Evidence for Two X-ray Reprocessors in MCG -5-30-16*, (Weaver et al.).
- (iv) *X-ray Observations of LINER and Starburst Galaxies* (P. Serlemitsos, A. Ptak and T. Yaqoob, to be published in proceedings of *The Physics of Liners in View of Recent Observations*).

Poster Papers

The Iron K Line Profile in NGC 4151 and the Evidence for a Relativistic Accretion Disk (Yaqoob et al.). AAS Meeting, San Antonio, January 1996.

Talks

Challenges for Models of AGN from recent ASCA Data.

Seminar, Institute of Physical and Chemical Research (RIKEN), Tokyo, Japan, December 4 1995.

Some Topical Issues from Recent AGN Data.

ASCA calibration workshop, Institute of Space and Astronautical Science, Tokyo, Japan, December 5 1995.

Iron K Lines in AGN.

Seminar, Catholic University, Washington, DC, January 25 1996.

Physical Constraints From Recent ASCA Observations of the Iron Line in AGN.

International Symposium, *X-ray Imaging and Spectroscopy of Cosmic Hot Plasmas* at Waseda University, Tokyo, Japan, March 12 1996.

Papers Refereed

Spectral Variability in the ASCA Observations of the Seyfert 1 galaxy NGC 4051 (Guainazzi *et al.*). Paper submitted to Publications of the Astronomical Society of Japan (PASJ).

Proposals Accepted (ASCA)

1. *Hard X-ray Observation of the Ultra-soft Variable Narrow Line QSO Ton S 180.* (Yaqoob *et al.*). One Source.
2. *Response of the Iron Line to the Rapidly Variable Continuum In NGC 7314.* (Yaqoob *et al.*). One Source.
3. *Diagnostics of an Active Nucleus Using the Furthest Detected Iron K Line at $z=0.66$.* (Serlemitsos *et al.*). One Source.
4. *Iron Line Monitoring of MCG -5-23-16.* (Weaver *et al.*). One Source.
5. *X-ray Observation of Optically Selected Quasars.* (George *et al.*). Two Sources.

Programmatic Work

Since October 1995, I have been a member of the ASCA Guest Observer Facility (GOF) scientists. Duties include U.S. Guest Observation planning and answering technical questions on the e-mail exploder 'ascahelp' on a rota basis with the other three ASCA GOF scientists. In February/March 1996 I was also responsible for producing/coordinating a revised version of the ASCA technical appendix in preparation for the AO-5 research announcement.

Work Planned for Next Period

In the next period, work on the above projects will be continued. New projects will also be undertaken using data recently obtained or scheduled. These will include ASCA data for the active galaxies NGC 7314, MKN 205, PKS 0637-752, TONS 180 and NGC 3227. An XTE observation of the latter source is also scheduled. Further proposals will be written for ASCA AO-5 period.

SEMI-ANNUAL TECHNICAL REPORT FOR 1 OCTOBER 1995 - 31 MARCH 1996

Charles Day, XTE Guest Observer Facility

On 1st October 1995 I changed positions within the HEAP: I left the ASCA Guest Observer Facility and joined the XTE Guest Observer Facility.

My responsibilities in the XTE GOF are to:

1. Write and edit documentation used by Guest Observers
2. Produce and maintain the XTE GOF web page, the URL of which is:
http://heasarc.gsfc.nasa.gov/docs/xte/xte_1st.html
3. Support, with my fellow GOF scientists, visiting Guest Observers and the xtehelp email hotseat.
4. Contribute generally to the effective working of the GOF.
5. Conduct scientific research.

In fulfilling the first two, I have written a total of 157 Kbytes of text. Largest of these documents are:

"The ABC of XTE" - A comprehensive guide to reducing and analyzing XTE data. About to be released to the public in partial form, it currently occupies 86 Kbytes. The URL is:
http://olegacy/0/docs/xte/abc/front_page.html

"XTE Getting Started Guide" - The first document that Guest Observers should read. It explains how to read data from tape, how the data are organized, how to browse the contents of the tape and where to start with data reduction and analysis. It is publicly released, occupies 8 Kbytes, and is available at:

http://heasarc.gsfc.nasa.gov/docs/xte/start_guide.html

"XTE Archive" - A guide to using the newly opened XTE Archive. It explains the archiving policy, how data are organized in the Archive, and how to find and retrieve the data. It is publicly release, occupies 5.6 Kbytes, and is available at:

<http://heasarc.gsfc.nasa.gov/docs/xte/archive.html>

The XTE GOF opened to visiting Guest Observers at the end of the period covered by this report. I supported Dr. David Smith (University of Maryland) during his GOF visit 28-29 March 1996.

On the scientific front, two papers on which I am a co-author were published or accepted between 1 October 1996 and 31 March 31:

Pravdo, S. H., Day, C. S. R., Angolan, L., Harman, B. A., Yeshiva, A., Sarasota, P. 1995.
"ASCA and GRO Observations of GX 301-2", *Astrophys. J.*, 454, 872.

Choi, C. S., Dotani, T., Day, C. S. R., Nagase, F., 1996. "Pulse-phase Spectroscopic Study of Vela X-1," *Astrophys. J.* accepted.

A third paper on which I am a co-author, Ebisawa et al., has been resubmitted in response to referee's comments.

Finally, I have joined the OGIP X-ray Public Outreach Group. My activities so far have included spending a morning hosting two pupils from Gwynn Park High School and writing a piece for the HEASARC's new Learning Center homepage.

James Lochner
LHEA Office of Guest Investigator Programs
Code 660.2
(Activity 5030-04A-39)

Semi-annual Report
October 1, 1995 - March 31, 1996

With the successful launch of XTE on Dec 30, 1995, this 6 month period saw a transition between final preparations for the XTE launch and servicing the first few months of guest observer operations. Hence this semi-annual period saw hectic development of a number of projects to facilitate getting software, calibration results, and observation status out to guest observers.

The bulk of my effort has been toward the development of calibration software and data files. Continuing to work with Ian George (USRA/HEASARC), we finished the development of the scheme for placing XTE calibration files into the publicly available HEASARC Calibration database. I also developed and put in place the means by which the instrument teams can deliver new and updated calibration files to the GOF. We tested the systems using the pre-launch calibration files, and made appropriate adjustments when the first post-launch calibration files were received. We have learned the necessity of being flexible, as the needs of the instrument teams has already evolved.

Working with Ian and members of the PCA instrument team, we completed development of the software for constructing PCA response matrices appropriate for any guest observer's PCA observation. The PCA team provided the fundamental codes appropriate for their instrument, Ian provided general software codes for working with the calibration files, and I provided additional tools and an overall structure for carrying out the process using the various software tools. This system was in place before launch and tested with mission simulation data. After launch, with "real" data, we were able to further test, revise, and update the software. At the end of this semi-annual period we were approaching a stable state, although updates are expected to continue.

In addition to servicing the community using the HEASARC's Calibration Database, I've also been working with Arnold Rots (USRA/XTE GOF) to provide the calibration files for the XTE database. This is a delicate balance between the requirements and in-place structures of the HEASARC and those of the XTE database. We have developed a number of compromises, but such challenges doubtless remain in the future.

In the months before launch, I continued to take the lead in developing the process by which the All Sky Monitor (ASM) results would be incorporated into the HEASARC public archive. The ASM results are produced by software provided by the instrument team at MIT. By Oct 1, we had settled on the fundamental means of getting the real time data from the XTE Science Operations Facility (SOF) to the HEASARC, and for getting the definitive results from MIT to the HEASARC. We completed the implementation of these pathways and started testing them. Tom McGlynn (USRA/HEASARC) contributed by heading up the organization at the HEASARC end, and promising to provide a pictorial representation of the results in addition to simply the data files. The SOF to HEASARC test was successful, but complete end-to-end testing was limited because of problems with MIT supplied software to generate the results in ascii format and software to convert ascii results into FITS files. The subsequent instrument problems with the ASM after launch prevented MIT from being able to fix these problems. At the end of this semi-annual period, with the ASM now up and running, the HEASARC and the GOF remain poised for when MIT is able to provide results and updated software. We expect this to be in the coming couple of months.

During the past few months I have also participated in the development of Argus, a HEASARC Web facility which guest observers can use to track the status of their proposals and observations. I have provided consultation to the HEASARC team developing this facility on matters concerning XTE. This has involved information regarding how the XTE schedules are created, and how the XTE data is processed. I have assisted as needed in making the connections between the HEASARC team and the appropriate members of the XTE team so that Argus may be appropriately and automatically updated. At the end of this semi-annual period, Argus successfully tracks proposals through the "observed" state, and includes details concerning the data modes used for the observation. In the near future, Argus will track observations to the "processed" state.

During this semi-annual period I followed up on work done by Mr. James Humphries, who was a GSFC Summer Teacher Intern with me last summer. We had developed the concept for an XTE Learning Center, and Mr. Humphries developed the materials for it. These materials allow teachers and their students to explore fundamental physical concepts using publicly available data from XTE and the HEASARC. I converted the materials to HTML documents and developed an XTE Learning Center Web site. This site went public at the end of February, and has drawn much attention.

At about the same time I accepted the responsibility from Dr. Nicholas White of heading up a Public Outreach group for the X-ray and OGIP groups at LHEA. His initial invitation was met

with good response from about 15 USRA and STX employees. The purpose of the group is to coordinate outreach and education activities, with an initial focus on developing an outreach site for the HEASARC. We have set about learning about opportunities for education and public outreach and resources available at Goddard. With Dr. Laura Whitlock (USRA/HEASARC) taking a significant leading role, the group developed materials for her concept of the HEASARC Learning Center. This web site encompasses many fields of high energy astrophysics studied by USRA scientists in the Lab. This site is planned for a limited public release (e.g. within the Lab) in April, and a more general release in May. In the coming months, I anticipate that this group will continue to contribute to this Web site, in addition to looking for other teacher/student contact opportunities.

Technical Report
October 1995 - March 1996

Arnold H. Rots

USRA
Code 660.2
Task number 5030-04A-39

During this period the XTE launch took place. I delivered a great many software products.

1. XFF

The FITS formatter was further upgraded and perfected. It is a software system of considerable sophistication and flexibility. I am hoping that we will get a chance to turn it (and the associated software subsystems) into a general mission pipeline package. It should be rather easy to generalize it further, so that it can be adapted to almost any new mission. The concept is very simply to take generic CCSDS packets and turn them into a FITS database. Production, realtime, and quick look versions are running.

2. XTETime and xTime

Two tools for the conversion of time. Various parts of the mission are using different time systems and formats, but obviously need to be able to communicate. XTETime is a collection of classes that allows these conversions, but also manipulating timeranges and lists of timeranges. xTime is a user tool, based on XTETime, that allows conversions between time systems TT, MET, and UTC, and formats JD, MJD, seconds, day-of year, calendar date and mission day. It has proved to be very useful.

3. ObsCat

Since the Mission Monitoring subsystem collapsed, I had to provide a substitute in order to allow the processing of XTE data. This program basically adjusts the start and stop times of observations depending on what the telemetry shows and inserts slew observations. It tries to estimate the amount of good time.

4. XDF

The XTE Data Finder has proven to be a very popular and successful tool for navigating the database. We have plans to extend its functionality to make it the ultimate interface to the reduction and analysis programs and allow it to work as a virtual remote analysis engine: the user could run it in his/her own environment without needing the entire database; only a skeleton will be needed and XDF will take care of retrieving whatever data files are need in a fully transparent way.

5. Data Security

Aside from the proposed FITS standard checksum, I have included a (FIPS standard) Secure Hash Algorithm mail digest for each data file in the database, so that anybody can double-check on the data's integrity.

6. Mission Database

The database is now fully in operation at XSDC. I feel that the careful design has paid off considerably, for instance in the capabilities that XDF provides. After some hiccups and hardware problems, XSDC production is working fairly smoothly now. Users have not complained about the database - which is encouraging. A README file is distributed with each tape. I have been closely involved in the interaction with the people in code 630 (both XSDC and MDSS) on mission database issues.

7. Guest Observer Activities

The XTE GOF has had its first visiting GOs. It seems that they are quite happy. In addition, the GOF scientists are taking turns on the help desk. I have participated in both types of activities. In addition, I have written a large volume of documentation

8. Clock

I have spent a fair bit of time on checking out the spacecraft clock and various time corrections. In connection with that I have duplicated the Ftool code that calculates barycenter corrections; duplication is necessary, here, to ensure accuracy. There are various sources of errors that will be addressed:

- The barycenter code; this has been corrected to much better than 100 us - but needs to be 1 us or less.
- The code to check absolute timing (against the radio pulsar database). This is currently in progress.
- The JPL DE200 ephemeris, or rather, the extract that is in use in code 660. This is only guaranteed to be good to 100 us and will need to be addressed in the near future.
- The clock calibration and corrections. A simple polynomial (second order) should suffice to bring the clock errors down from the 100 us to less than 10 us level.
- The orbit ephemeris. This will be the next major issue.

9. Research

I have started analyzing my first XTE observations, on the pulsar B1509-58. Part of this work is done under the auspices of the clock activities mentioned in the previous paragraph.

10. Outreach

I judged the science fair at Bowie High School.

USRA REPORT 10/1/95 - 3/31/96
Dr A.B.Giles
Activity: 93-05-00

During the above period Dr Giles continued as the Software Manager for the PCA experiment software development. This period actually covers two distinct phases of the mission. From 10/1/95 to 12/30/95 XTE was supported for launch preparations and testing. On December 30th XTE was finally launched and so the first 3 months of 1996 involved support of the In Orbit Checkout (IOC) period followed by mission operations and the start of real data analysis.

Meetings:-

Dr Giles regularly attended the following list of meetings at GSFC in connection with the PCA experiment:

PCA representative on the SOF meetings	alt. Mondays
PCA full team group meeting	Tuesday & Friday
PCA representative on GOF meetings	occasional

Other specific meetings or activities supported were:

Support 5th Mission Simulation	25 Sept 95	GSFC
This was an additional Sim due to the launch slips.		
Support Pad Functionals	19 Nov 95	GSFC
Intense support for 1st IOC week	1-8 Jan 96	GSFC

Conferences:-

None

Dr Giles was to present a paper at the IAU Colloquium 160 on Pulsars in Sydney, Australia, during 8-12 January 1996. He had to cancel the trip when XTE finally launched 4 days before he was due to leave the USA.

Travel:-

Visit to Leicester University (UK) on 16th November 1995 (privately funded trip). While in the UK Dr Giles had a major problem in getting a visa stamp at the US Embassy in London in order to return to the USA. The Embassy suddenly closed without warning due to the Government Furlough back in the USA.

Visit to KSC from December 9th to 17th 1995 for the launch of XTE. This was another privately funded trip.

Activities:-

There were almost no activities outside the overwhelming constraints imposed by XTE. As Software Manager Dr Giles continues to coordinate the work of the following programmers:

Hwa-ja Rhee	Hughes STX	PCA Science Monitoring
Vikram Savkoor	Hughes STX	PCA Commanding, Health & Safety

In general the PCA code and documentation were in excellent shape to support the planned launch on August 31st and the continuing slips through the latter half of 1995 allowed extra finishing touches. Some small bugs were fixed and additions made. The major support activity for Dr Giles was the endless command load checking of the Daily Activity Plans as the SOF struggled to get this complicated subsystem ready for a launch. Dr Giles also started to devise some new PCA Science Monitoring displays and many upgrades and improvements were made during the first 3 months of the mission. During October and November there were twice weekly playbacks of data through the SOF system to test everything which PCA (Dr Giles) had to support.

There were many (10 ?) tentative launch dates for XTE after August 31st passed. All these slippages were due to the Delta 2 rocket problems. XTE was ready! Finally serious attempts were made on 10, 11, 12 and 17 December while Dr Giles was in Florida. These attempts were scrubbed due to red limit winds. On 18 December the main engine failed to ignite at -2.5 seconds. On 29 Dec high winds again caused a scrub. Finally on 30 December XTE had a perfect launch.

The first week of IOC was particularly challenging and Dr Giles manned the night shift (19:00 to 07:00) in the Science Operations Center at GSFC. This was the shift on which all the early experiment commanding, testing and early science test observation were conducted. Having managed the development of all the PCA commanding and real time monitoring subsystem Dr Giles played a crucial part in the successful conclusion of this first phase of the IOC period. The subsequent 3 weeks of IOC required long hours of normal day time effort.

During the last 2 weeks of March some problems developed with 2 of the 5 PCU's on XTE and this became a major diversion from analysing data. Dr Giles has maintained a detailed running report/log of the anomalies and activities associated with these detector problems for Dr Frank Marshall, the Director of the Science Operations Center and Jean Swank, the PCA Principal Investigator and XTE Project Scientist.

XTE Observations:-

The following were monitored in real time:-

- 1/27/96 GRO J1744-28 (PI Giles - generic TOO proposal)
- 2/12/96 Cyg X-1 run 1 (PI Giles)
- 2/15/96 Cyg X-1 run 2 (PI Giles)
- 2/17/96 Cyg X-1 run 3 (PI Giles)

Most public domain observations of GRO J1744-28 were also monitored in real time by Dr Giles. Data analysis on the PI observations is under way.

Documents:-

Final versions of all PCA software documents produced and circulated - 1 copy in the SOF, 1 copy in the GOF, 1 copy in the PCA operations room in building 2.

Publication Activities:-

In September 1995 Dr Giles wrote a piece entitled "Mirrabooka - The Satellite That Never Was" and submitted it to the Space Industry News

(SPIN) bi-monthly publication of the CSIRO in Australia. This article was to mark the 10th anniversary of a satellite project in the mid 1980's which was never funded. Dr Giles had been the acting project manager for the "front running" payload proposal. SPIN, No. 67, 7-8, 1995.

During mid-1995 Dr Giles wrote a popular style article on XTE and X-ray astronomy for the Australian magazine "Southern Sky". Unfortunately by the time it was ready for submission the magazine had ceased publication (after quite a few years in circulation). Dr Giles then submitted the article to another Australian magazine entitled "Sky and Space". This item was accepted in March 1996 but the publication date is uncertain.

Dr Giles submitted his paper entitled "An Efficient Method for the Detection of Infrequent Rapid Bursts" to ApJ on 2/17/96.

In January 1996 two abstracts were submitted for the HEAD meeting at San Diego in May. Two abstracts were also submitted for the COSPAR meeting at Birmingham, England, in July.

IAUC 6291 on GRO J1744-28 (Swank et al - XTE team) was published on January 21st 1996.

On 3/13/96 Dr Giles talked to Bob Zimmerman by phone about GRO J1744-28. Mr Zimmerman was writing an article on this X-ray source for the journal "Science". This may appear in the April issue.

IAUC 6338 on GRO J1744-28 (Giles & Strohmayer) was published on March 8th 1996.

A poster paper "Real Time Science Displays for the PCA Experiment on XTE" was displayed from 26-29 March 1996 in the GSFC Atrium in Building 6 as part of the USRA display week.

Next 1/2 year:-

- a) Support all aspects of PCA detector anomaly tracking.
- b) Continue to manage development of extra PCA science monitoring capabilities.
- c) Analyse XTE PI data and some public data.
- d) Attend the HEAD meeting.
- e) Attend the COSPAR meeting.
- f) Write new proposals for the 2nd XTE NRA which closes on 6/30/96.

Dr. William Zhang

Semi-Annual Report: 1 October 1995--31 March 1996

This report briefly describes my activities under 5030-05A-39 covering calendar time from 1 April 1995 through 30 September 1995.

I. XTE Launch and In-Orbit Check-out of the PCA

The XTE satellite was launched on 30 December 1995. The PCA check-out was started on 6 January 1996. I developed the necessary software to monitor PCA parameters, such as energy gain, time resolution, pressures, temperatures, etc., off-line and to perform statistics on those parameters.

II. XTE Detector Characterization

My effort to characterize the PCA characteristics continued in this quarter. My emphasis has been mainly on its timing characteristics. Although I did a lot of work before launch, those parameters still had to be adjust for the real configuration after launch to take into account those parameters depending on individual observations.

III. Work on Possible New Mission Ideas

I initiated or actively participated in writing three DDF proposals. Due to some Goddard internal regulations, I could not be Principal Investigators on these proposals, but I did play major roles in creating the ideas and writing the proposals.

(1) Development of an All Sky Monitor Using Mylar Sheets Coated with Aluminum/Gold, (PI: Robert Petre). In it we propose a new technology to improve the signal/background ratios of monitoring existing sources and covering the entire sky almost 100% of the time, as compared to 1-10% of the time of past all sky monitors. This proposal is intended to be the first step toward writing a SMEX proposal that will be written in response to an official NASA AO expected to be released sometime next year. This proposal was accepted by the Goddard Director and is funded for study. I have been working with Dr. Rob Petre of Goddard to further evaluate the parameters of this concept.

(2) Big Balloon X-ray Collector (BBXRC), (PI: Elihu Boldt). In it we propose to construct a large balloon to get 100 square meters of soft X-ray collection area. If successful, it should enable us to study X-ray sources for very fast (less than 1 microsecond) time variability. This proposal was also accepted by the Goddard Director and is funded for study. Dr. Boldt and I have been working with two companies which specialize in making scientific balloons to see if they can make the balloons we want.

(3) Prototype Curved Focal Plane Detectors for X-Ray Astronomy, (PI: Keith Jahoda). In it we propose to use the microstrip detector technology to produce curved, either cylindrically or spherically, detectors which are necessary for the next generation of X-ray telescopes. This proposal was not accepted for funding. However, the idea of making microstrip proportional counters is well-received at LHEA. Currently the LHEA management has made funds available for me to purchase from a Swiss company some testing plates. We are proceeding to make some test counters.

IV. Visit to the Los Alamos National Laboratory

Drs. Nick White and Keith Jahoda of GSFC and I visited the Los Alamos National Lab in February. We agreed to set up a collaboration among the two institutions to write a SMEX proposal to NASA to do an All Sky Monitor. During the meeting I presented my initial study on a new optic for an All Sky Monitor.

IV. Scientific Research

With the XTE data becoming available, I have spent a fair amount of my time analyzing them. So far I have published the following IAU circulars:

- (1) Quasi-periodic oscillations from GRO J1744-28 (Zhang et al...)
- (2) Discovery of 800 Hz QPO from 4U 1728-24 (Strohmayer, Zhang, and Swank)
- (3) Discovery of 1100 Hz QPO from SCO X-1 (van der Klis and Zhang et al..)
- (4) Discovery of 850 Hz QPO from 4U1608-52 (van Paradijs and Zhang et al..)

Right now I am writing papers on some these initial results for publication in refereed journals.

Semi-Annual Technical Report
(1 October 1995 - 31 March 1996)

Name: Wan Chen
Position: Research Scientist
Task Number: 5000-643
Date: 9 April 1996

Trips:

(a) 21-27 January 1996, Aspen Winter Conference on Astrophysics, "Black Hole X-Ray Transients", presented an invited talk on "Properties of X-Ray Nova Light Curves".

(b) 20-23 March 1995, Clemson Workshop on "Galactic Radioactivity", presented an invited talk on "Modeling the Galactic ^{26}Al distribution".

Paper published:

[1] "The Accretion Disk Limit Cycle Instability in Black Hole X-Ray Binaries", John Cannizzo (USRA/GSFC), Wan Chen (USRA/GSFC), and Mario Livio (STScI), *The Astrophysical Journal*, v. 454, p. 880-894, (1 December 1995)

[2] "On the Spiral Arm Interpretation of COMPTEL ^{26}Al Map Features", Wan Chen (USRA/GSFC), Neil Gehrels (NASA/GSFC), Roland Diehl (MPE), and Dieter Hartmann (Clemson), *Astronomy & Astrophysics*, submitted on 2 October 1995, now in press.

[3] "Radial Velocity Map and Line Profiles of ^{26}Al Emission from Galactic Rotation", Neil Gehrels (NASA/GSFC) and Wan Chen (USRA/GSFC), *Astronomy & Astrophysics*, submitted on 2 October 1995, now in press.

[4] "Search for 1.809 MeV Emission of ^{26}Al from Nearby Supernova Remnants Using COMPTEL", Juergen Knoedlseder (MPE), Wan Chen (USRA/GSFC), Uwe Oberlack (MPE), Roland Diehl (MPE), and Neil Gehrels (NASA/GSFC), *Astronomy & Astrophysics*, submitted in October 1995, now in press.

[5] "Modelling the 1.809 MeV Sky: Tracers of Massive Star Nucleosynthesis", R. Diehl (MPE), K. Bennett, H. Bloemen, C. Dupraz, W. Hermsen, J. Knoedlseder (MPE), G. Lichti (MPE), D. Morris (UNH), U. Oberlack (MPE), J. Ryan (UNH), V. Schoenfelder (MPE), A. Strong (MPE), P. von Ballmoos (CESR), C. Winkler, W. Chen (USRA/GSFC), D. Hartmann (Clemson), and N. Prantzos (IAP), *Astronomy & Astrophysics*, submitted in October 1995, now in press.

[6] "Possible Detection of π^0 Decay Gamma-Ray Emission from Cyg OB2 by EGRET", Wan Chen (USRA/GSFC), Richard L. White (STScI), and David Bertsch (NASA/GSFC), *Astronomy & Astrophysics*, submitted on 15 December 1995, now in press.

Paper submitted:

[7] "The Properties of X-Ray and Optical Light Curves of X-Ray Novae", Wan Chen (USRA/GSFC), Chris Shrader (USRA/GSFC), and Mario Livio (STScI), 1996, *The Astrophysical Journal*, submitted on 3 January 1996 (now in the process of revision).

Dr. Eric R. Christian
NASA/GSFC Mail Code 661

April 11, 1996

Semi-Annual Technical Report
October 1995 - March 1996

ACE (Advanced Composition Experiment): ACE is an Explorer that is planned for launch in 1997 to study the solar wind, and heliospheric and low energy galactic cosmic rays. I am assistant to the Project Scientist (Jon Ormes). This requires spending a considerable amount of time in meetings and facilitating communication between the project management here at Goddard, the spacecraft contractor (JHU/APL), and the experiment teams. As we approach delivery of the instruments (May through August 1996), I've been spending more time on ACE (approximately 65%), and this will continue. I am a member of the ACE Mission Operations Working Group, the Spacecraft Operations Working Group, and the Initial Operations Working Group. I attend the weekly Code 410 ACE Staff meeting, the bi-weekly spacecraft status meetings, and science team meetings as scheduled. I am writing a periodic "What's New on ACE" newsletter for the science team and am the author and curator for about 40 pages on the World Wide Web for the ACE spacecraft (<http://www.gsfc.nasa.gov/ace/ace.html>). I also am on the science team for two of the ACE instruments (the Cosmic Ray Isotope Spectrometer and the Solar Isotope Spectrometer) and have been helping with the integration and environmental testing for these instruments.

IMAX (Isotope Matter-Antimatter eXperiment): IMAX is a balloon experiment which we are working on with Caltech, U. of Siegen, and NMSU to measure the fluxes of anti-protons, and hydrogen and helium isotopes over a wide energy range. Our first paper "Measurement of 0.25 - 3.2 GeV Antiprotons in the Cosmic Radiation" by Mitchell et al. has been accepted in Physical Review Letters and will be published in April. We are working on our next paper on helium isotope ratios.

ISOMAX (ISotope MAGnet eXperiment): This is another magnetic spectrometer balloon experiment in collaboration with Caltech and U. of Siegen. It is specifically designed to look at the isotopic composition of beryllium, because ^{10}Be is a very important clock that can measure the lifetime of all cosmic rays. I am responsible for the onboard command and data handling (C&DH) system and the computer ground support equipment (GSE). The hardware is working, and functional C&DH and GSE software systems are up and running, but both systems are in the process of being expanded.

TIGER (Trans-Iron Galactic Element Recorder): TIGER is a balloon borne experiment designed to look at ultra-heavy galactic cosmic rays. It is a collaboration with Washington U. (St. Louis) and U. of Minnesota. After the balloon failure we had last summer, we are making some improvements and working towards flying it again this summer. I am Goddard instrument manager for TIGER (meaning I am taking the lead for the Goddard part of the instrument). We are also working on a Advanced Mission Concept proposal (with the addition of Caltech) with the intent of eventually proposing a TIGER MDEX.

ALICE (A Large Isotopic Composition Experiment): The final ALICE paper is now accepted in Astronomy and Astrophysics!! In October I took a trip to Germany that included a week at the University of Siegen to answer the referee's comments. This should be the last we hear of ALICE except for getting the final citation.

Voyager Cosmic Ray System: I continue to work with Drs. Ed Stone and Alan Cummings of Caltech on a paper for the Astrophysical Journal. During a trip to Caltech in February, I was able to do quite a bit of the data analysis for this next paper, as well as two upcoming talks for the AGU and COSPAR conferences.

On top of all this, I continue to be system manager for two UNIX computers.

TO: David Holdridge/610.3, USRA
FROM: Scott Barthelmy/661
RE: April 1995 through April 1996 Report

Introduction:

I checked my records and it has been a year since I submitted my last "quarterly" report. Part of the lack is due to being in Australia for the Fall 95 campaign for 3-plus months, but I suspect that I also just forgot for the other reports. So this report will cover the last 12 months of activities, but even so, it will be a little terse.

GRIS project activities:

The GRIS balloon instrument was flown successfully for a record 3 times in a single campaign. We got a 12 hour and two 24-hour flights. The instrument worked perfectly all 3 flights, however, the balloon for the first flight was a "leaker" and never achieved full float altitude. This was a new configuration for the GRIS instrument with the new wide field of view collimator shield crystal. With it we made drift scan observations of the Galactic Plane and the South Galactic Pole. The former found a somewhat surprising amount of 511keV positron annihilation radiation emission from the Plane. The cosmic diffuse measurement from the South Pole has not shown any "features", but my analysis is only preliminary at this stage. I will present the final results on the cosmic diffuse at the "Second Integral Workshop" this Sept in St.Malo, France.

PORTIA project activities:

After the cancellation of the Spring 95 campaign to Australia, a crash program was started to make the PORTIA piggy-back detector into a standalone gondola, which we flew from Palestine, TX in Jun 95. The flight was a complete success, and was the first ever measurement of the background in CZT detectors in a space-like environment. The PORTIA detector was also flown again during 2 of the 3 GRIS flights in Australia in the Fall (see above). The first was as a piggy-back instrument to make a confirming measurement of the background spectrum, and for the second flight GRIS was modified to allow for PORTIA to be completely inside the GRIS anti-coincidence shield. This yielded a measurement of the true intrinsic, internal background spectrum of CZT. These results were critical to our MidEx proposal.

BACODINE project activities:

The BACODINE project continues grow. The number of operations is 26 by 110 researchers at 38 sites around the world with 44 separate instruments. They have made a total of 152 follow-up observations on 140 GRB in the radio, optical, and TeV gamma-ray bands. About half of the BACODINE operations are universities.

I was successful with my GRO Cycle 5 Guest Investigator proposal, and just last week submitted the Cycle 6 BACODINE renewal proposal.

Because I was in Australia, I was not able to attend the "Third Huntsville GRB Workshop", however, BACODINE continues to show its productivity by yielding 13 papers at the conference. There have been 3 other papers published from BACODINE operations. I have attached a publications list below (I am co-author on all papers).

GTOTE project activities:

This project was in a period of minimal activity, but is now gearing back up in the last couple months. It should become operational in the next couple months.

GRB Follow-up Proposals:

My Kitt Peak Schmidt telescope GRB follow-up ToO proposal was not renewed. The KPNO WIYN telescope (I am Co-I) GRB follow-up proposal was accepted.

Other Proposals:

My XTE proposal to turn it into a system like BACODINE was accepted. While XTE was designed for pointed observations, it does have more than two-pi steradians response to strong GRBs and it also has real-time telemetry. This makes it amenable to BACODINE-like operations. It will add the "third leg" in the required "tripod" for the Interplanetary Network to produce small (<1arcmin) error boxes. I started development of the system -- some very preliminary software was written to interface to the PACOR II system to access the XTE telemetry stream.

The BASIS MidEx proposal (for which I was responsible for the real-time telemetry design and rapid GRB location determination and distribution aspects) was not accepted. Our group is currently redesigning BASIS for the SMEX program. We will submit it Jan 97.

Publication List:

Dessenne, C.A.-C., et al.; MNRAS; submitted; Mar 1996; "Searches for Prompt Radio Emission at 151 MHz from the Gamma-ray Bursts GRB 950403 and GRB 950706"

McNamara, B, et al., ApJ.Supp.; 103; 173; 1996; "Ground-based Gamma-Ray Burst Follow-up Efforts: Results of the First Two Years of the BATSE/COMPTEL/NMSU Rapid Response Network"

Krawczynski, R., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Search for TeV Counterparts of BATSE GRBs with the HEGRA Extensive Air Shower Arrays"

Katz, C., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "The STARE Project: First Light"

Hudec, R., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Searches for Optical Counterparts to GRBs: EON and AIO"

Hewitt, J., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "A 23GHz Survey of GRB Error Boxes"

Connaughton, V., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Searches for TeV Counterparts to Classical GRBs"

Barthelmy, S.D., et al.; in "Proceedings of the Huntsville Third GRB Workshop" AIP, New York; in press; 1995; "Progress with the Real-time BATSE GRB Coordinates Distribution Network (BACODINE)"

Balsano, R., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Searching for Prompt Radio Counterparts to GRBs"

Baruch, J.E.F., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Prompt Acquisition of GRB Optical Counterparts with the Bradford Telescope"

Funk, B., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Status of the High Energy GRB Counterpart Search with HEGRA-EAS Experiment and Its Air Cherenkov Telescopes"

Green, D., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Limits on Prompt Emission from GRB 950430 and GRB 950706 at 151MHz"

Lee, B., et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "Results from GROCSE I: A Real-Time Search for GRB Optical Counterparts"

Park, H-S, et al.; in "Proceedings of the Huntsville Third GRB Workshop"; AIP, New York; in press; 1995; "GROCSE II: A Real-Time Search for GRB Optical Counterparts"

Krawczynski, R., et al.; in "Proceedings of the 24th ICRC, Rome, Italy"; 1995; "Search for TeV Counterparts of 1994 & 1995 BATSE GRBs"

Hudec, R., et al.; Proc of the 29th ESLAB Symposium; Ap&SS; 231; 335; 1995; "European Observation Network: First Experience with BACODINE Triggers"

Green, D.A., et al.; Proc of the 29th ESLAB Symposium; Ap&SS; 231; 281; 1995; "A Search for Prompt Radio Emission from GRBs"

Akerlof, C., et al.; Proc of the 29th ESLAB Symposium; Ap&SS; 231; 255; 1995; "Results from GROCSE, a Real-Time Search for the Optical Counterparts of GRBs"

Barthelmy, S.D., et al.; Proc of the 29th ESLAB Symposium; Klewar; Ap&SS; 231; 235; 1995; "BACODINE, The Real-Time BATSE Gamma-ray Burst Coordinates Distribution Network"

Harrison, T, et al.; A&A; 297; 465; 1995; "Preliminary Results from the Ground-based BATSE/COMPTEL/NMSU Rapid Response Network for GRBs"

Semi-Annual Technical Report
David Palmer
October 1995-March 1996

During the past six months, I have been primarily involved in TGRS data analysis and in proposal and development work for two new instruments: InFOCuS and BASIS.

TGRS

TGRS, the Transient Gamma Ray Spectrometer, is a high-resolution gamma-ray spectrometer designed with a primary mission to look for features in gamma-ray burst (GRB) spectra. Discovery of these features would provide strong evidence of a Galactic origin of GRBs (or, at least, that particular GRB).

In addition to the normal analysis of TGRS data, I am developing software to look for new kinds of transient gamma-ray phenomena. Most detected GRBs show variability over timescales of a few seconds or less. Slower variations are indistinguishable from the large variations produced by changing particle backgrounds encountered by instruments in Low Earth Orbit, where the background varies by as much as a factor of two during each 90 minute orbital period. TGRS, on the other hand, spends much of its time in interplanetary space, outside of Earth's magnetosphere, and is thus well-placed to notice transient sources that rise slowly over time periods of minutes, hours, or days. In addition, there is a type of transient, seen only once, which has a pure line spectrum. TGRS's high resolution is useful for observing this type of transient.

PROPRIETARY INFORMATION do not disseminate

InFOCuS

The International Focusing Optics Collaboration for MicroCrab Sensitivity instrument is a proposal which combines two recent advances in gamma-ray instrumentation: hard X-ray (up to ~80 keV) focusing optics, and high spatial- and energy-resolution CdZnTe gamma-ray detectors.

We have proposed a balloon instrument that could detect a source that is $1E-4$ times as intense as the Crab (100 microCrab) at energies from 20-40 keV and 60-80 keV. This will allow many observations that are orders of magnitude deeper than what is now possible. A follow-on space-based instrument would get down to 1 microCrab sensitivity. I have been working on the development of this instrument.

Burst Arc-Second Imaging Spectroscopy

I have also been working on the development of BASIS, a wide-field coded-aperture instrument that is optimized for accurately locating GRBs to within a few arc-seconds, allowing follow-up observations to search for the counterparts of the GRBs. This instrument was rejected for a Medium Explorer (MIDEX) but will be re-submitted as a Small Explorer (SMEX).

My role in these projects has been in testing the CZT gamma-ray detector, and developing the mask. The mask will be fabricated using X-ray lithography, producing a 100 micron-thick gold mask with 100 micron features on a beryllium substrate.

END PROPRIETARY INFORMATION

David Palmer

USRA Technical Report (Oct. 1, 1995–Mar. 31, 1996)

Helmut Seifert (Task #: 93-10-00; Activity #: 5030-10A-39)

Summary:

Since 1990, I have been leading the data analysis software development for the TGRS and Konus experiments on the GGS/WIND spacecraft. After the WIND launch on 1 November 1994, I have have also been responsible for instrument operations for TGRS. I have been responsible for generating the detector response for the TGRS instrument, and have started working on data analysis. I am also involved in software and modelling work for the SPI which is a new gamma-ray spectrometer aboard the European INTEGRAL observatory to be launched in 2001.

Activities:

Work on the development of the TGRS data analysis software is continuing in the areas of spectral deconvolution software and other special purpose software. This involves regular meetings and discussions with the instrument team and the programmers.

Monte-Carlo simulation code based on the GEANT software from CERN has been developed by me for the TGRS instrument, and has been used to generate the detector responses for our instrument. This work is crucial for calibration and the interpretation of our flight data.

I am also working on Monte-Carlo simulation code for the simulation of the SPI which is a new gamma-ray spectrometer aboard the European INTEGRAL observatory to be launched in 2001. The LEGR group at NASA/GSFC will play an important role in the software development for this instrument and will make contributions in the areas of spectral deconvolution, image processing, and background simulations. To this end, I participated in a workshop of the software development team at the Max Planck Insititute in Garching, Germany, from 2/17–25/1996.

I am currently working on the analysis of a bright gamma-ray burst (GRB) which was observed on August 22, 1995. This GRB was the brightest burst observed by TGRS since begin of the mission and will be used to study topics such as the spectral evolution, etc.

UNIVERSITIES SPACE RESEARCH ASSOCIATION

SEMI-ANNUAL TECHNICAL REPORT- 10/95 through 3/96

Employee Name: John W. Mitchell Activity: 5030-11A-39

During this reporting period, my main activities were the ISOMAX balloon program and analysis of the 1992 IMAX flight. I also worked on analysis of data from accelerator experiments, and development work on new flight and ground based experiments. Also, during the past six months, I worked on preparing several new papers.

ISOMAX - Isotope Magnet Experiment: The bulk of my activities during the past six months centered on ISOMAX, for which I am Instrument Manager. I am involved in all phases of ISOMAX design and construction. The ISOMAX renewal proposal, which was submitted to NASA in Summer, 1996 was given excellent reviews and ISOMAX has been funded through FY98 at close to the requested level.

At the time of writing, the first flight of ISOMAX has been postponed to Summer, 1997 due to delays in the construction of the magnet and in finding a location for the experiment ground testing with the magnet energized. However, during the past six months, ISOMAX development and integration has been ongoing. Much of the detector stack is complete, software development is well along, and the flight electronics system is nearing completion.

The instrument is based on a new large superconducting magnet for which I am responsible. This cutting-edge design, incorporating a large warm-bore for instrument mounting and a long-duration cryostat, is being developed by Oxford Instruments in England. Developing the coils for the magnet has been a difficult process. Two coil designs were tested and failed to meet the performance requirements of the magnet. In January, 1996, the decision was made to develop a third coil design. This design work is complete and it is expected that this design will be much more robust than its predecessors and will fully meet ISOMAX specification. At this point, magnet delivery is expected in 11/96. During the next six months, I expect to travel to England to work with Oxford on the magnet.

I am also responsible for the time-of-flight system and the experiment electronics. During this period I worked on the continuing development of hardware for the control and housekeeping interfaces for the experiment, the experiment trigger, and the low power electronics.

ISOMAX activities will occupy virtually all of my time during the next six months. These activities will include tests of the magnet (at Oxford Instruments in England), final construction of the TOF system, and integration of the instrument. It is expected that by the middle of the summer, the full instrument (less the magnet) will be functional.

IMAX (Isotope Matter-Antimatter eXperiment) - This instrument was built and flown by GSFC, Caltech, NMSU, and the University of Siegen (Germany). This is the first experiment to conclusively identify a substantial number of cosmic ray antiprotons by resolved mass. In addition, the light nuclear isotope identification is excellent.

During the past six months, I have been closely involved in examining and directing the data analysis. The analysis is in its final form. In particular, the cosmic ray antiproton results are now well understood, and during the last six months the initial IMAX antiproton paper (on which I am first author) was accepted for publication in Physical Review Letters.

I spent considerable time working on this paper to answer requests by one of the referees while maintaining the full content of the paper and keeping its length within the PRL guidelines.

During the next six months, I will be preparing a talk for the American Physical Society spring meeting and continuing to work on IMAX publications. The next paper to be submitted will be on the He isotopes, followed by a NIM article on the instrument.

MASS/WiZard: The WiZard-Related Balloon Program is conducted by an international collaboration with researchers from the U.S. (NMSU and GSFC), Italy, Germany, Sweden, India, and Russia. My responsibilities in this experiment are the time-of-flight system and the trigger electronics.

During the past six months, analysis continued on data from the several previous MASS/WiZard flights. A letter on the cosmic positron flux (measured by TS93) was accepted for publication during the last six months and papers on the antiproton flux (measured by MASS II) and the low energy positron flux (measured by CAPRICE) were submitted. During the next six months, I will be involved in preparing MASS/WiZard results for APS and ICRC talks and for publication. I will also be testing the MASS/WiZard TOF system (which I built) in preparation for a Spring, 1997 flight. During the next six months, I will be working on WiZard integration. This may involve a trip to NMSU.

SMILI (Superconducting Magnet Instrument for Light Isotopes): The SMILI instrument flew twice: in August, 1989, and in August, 1991 and two papers have been published on the results. During this period, analysis continued on data from both flights. The SMILI light isotope results are being prepared for publication.

E878 (ANTD): This is a program of experiments at the Brookhaven National Laboratory Alternating Gradient Synchrotron (AGS) to obtain the heavy-ion-collision production spectrum of pions, kaons and antiprotons in the energy range from 1.5 GeV to 24 GeV. E878 also conducted a high statistics search for the production of antideuterons or exotic particles in this energy range.

During this period, I participated in analysis of E878 data. A paper on the details of antiproton production in the E878 experiment is in preparation.

Experiments E683H and E849H: The results from E849H are being prepared for publication. The publication has reached a final draft stage for submission to the Physical Review. Following this publication, the analysis techniques developed for E849H will be applied to the E683H analysis.

Experiment E938H (Transport Collaboration): During the past six months, I participated in the analysis effort and in other collaboration activities. In particular, I directed work on improving the calculations of the particle flight times.

Several E938H papers are in final preparation. During the past six months, one E938H paper was published in Physical Review C and another was submitted to NIM. I contributed to both papers.

TIGER - Trans-Iron Galactic Element Recorder: This experiment is conducted by a collaboration between Washington University, the University of Minnesota and GSFC. During the past quarter, I worked on TOF system development as well as in general

experiment planning. I also worked on the experiment electronics. It is planned that the second flight of the instrument will take place in Summer, 1996.

During the past six months, I participated in understanding the post-flight analysis of the 1995 flight and in preparing for the 1996 flight. I also worked on plans for a space flight version of TIGER.

BESS - Balloon-Borne Experiment with a Superconducting Solenoidal Magnet Spectrometer: The BESS experiment is a search for low energy antiprotons and antihelium at a sensitivity much greater than current upper limits. BESS was flown for the second time in July, 1994.

During the past six months, the initial BESS paper was published in Physical Review Letters and considerable initial analysis was carried out in preparation for succeeding papers. During the next six months, I expect to participate in the preparations for a July, 1996 flight as well as in the preparation of additional BESS publications.

E896 (H0): This is a new experiment to search for the H0 dibaryon. The H0 is a six quark MIT bag (uuddss) that is predicted to be produced in great numbers in heavy-ion central collisions. However, it has a short lifetime and has not been detected as yet. The E896 experiment will conduct the most sensitive search to date for this particle. The experiment was accepted by the Program Advisory Committee (PAC) of the Brookhaven National Laboratory Alternating Gradient Synchrotron (AGS) in 3/94. This is one of the first completely new experiments to be accepted by the AGS in some time. I am Institutional Principal Investigator on this program

I have overall responsibility for the experiment electronics, including the fast event trigger, and for the high-rate beam detector system. This system will include a detector which will determine, in real time, the centrality of a particular nuclear collision. This is, in effect, a measure of the degree to which the colliding nuclei struck one another head-on. This determination must be made in about 100 ns.

During the past six months, I worked on the detector designs and participated in experiment planning activities. I attended E896 collaboration meetings at UC-Berkeley and UT-Austin. In addition, I worked on the superconducting sweeper magnet.

New Satellite Experiments: During the past six months I worked on the development of four satellite experiments to be performed by international collaborations.

PAMELA, is an Italian led experiment to conduct measurements of cosmic ray positrons, electrons, and antiprotons using a moderate-sized permanent magnet spectrometer. In December, 1995, I participated in a week-long PAMELA planning meeting in Florence, Italy. At this meeting, which included collaborators from Russia, Sweden, Germany, the US, and Italy, many of the technical details of PAMELA were worked out. GSFC will be responsible for the design of the time-of-flight system for PAMELA and will collaborate with the University of Siegen (Germany) in its implementation. I will play a leading role in this effort. During the past six months, I initiated the TOF design. Prof.-Dr. Manfred Simon and Michael Hof from University of Siegen worked for nearly two weeks with Dr. R.E. Streitmatter, Mr. Don Stillwell, and myself refining the TOF concept. During the next six months, I expect to complete the TOF design and work on the initial design report for PAMELA. I expect to travel to Florence, Italy for a meeting to finalize this report.

AGATE/GLAST. The next generation high-energy gamma ray telescope will need efficient, high-resolution tracking detectors. During the past six months I participated in developing an SR&T proposal to NASA to develop gas microstructure detectors for use in such a telescope.

UHED, is a satellite based follow on to TIGER. During the past six months, I worked with researchers at Washington University - St. Louis, GSFC, Caltech, and U. Minnesota to develop concepts for UHED as a "new mission concept" proposal to the NASA Space Physics Division.

Crystal Eye - During the past six months I worked on a number of aspects of a new experiment to measure ultra-high energy cosmic rays using a space-based detector looking at particle showers in the Earth's atmosphere. This experiment will be proposed as a "new mission concept" with Jonathan Ormes of GSFC as the P.I. I expect to have a lead role in the development of the focal plane detector array for this experiment.

Other Research Activities: I have been working with STAR (Solenoidal Tracker at RHIC) trigger group. In the future, I expect to be involved with the time-of-flight and the electromagnetic calorimeter.

USRA Activities: During the past six months, I continued as the Code 661 Group Leader.

Dr. Joseph A. Esposito
USRA Technical Report
01-Oct.-95 through 31-Mar-96

I. EGRET viewing period analysis:

I performed viewing period (VP) analysis on VPs 4270, 4280, 5010, 5080 and 5090. Each VP analysis consists of finding all point-like gamma-ray sources within the field of view, determining source intensities and positional error circle, comparing the determined source positions with known EGRET gamma-ray sources, comparing the determined source positions with possible Galactic gamma-ray sources (EGRET source list; SIMBAD catalog (Galactic) sources) and with possible extra-Galactic gamma-ray sources (EGRET source list; NED catalogue [extra_galactic] sources), producing tables (6), plots (2 + number of sources) and a summary report. Typical time to complete a single VP analysis is 7 working days.

II. EGRET Likelihood Analysis Software Maintenance:

I have continued to maintain the EGRET Likelihood Analysis Software. This has included:

Upgrading the software code to be consistent with present EGRET calibration information.

Establishing the Likelihood Analysis Software to conform with RCS program control.

Upgrading the software code to introduce new capabilities as requested by the EGRET instrument team.

Performing debugging analysis and instituting repairs to correct errors in the software.

Creating, writing and establishing on-line user help using the World Wide Web (WWW) HTML specification. The EGRET Likelihood Analysis Software user help is available from within the program as a spawned WWW browser (netscape) task or as an open location at the code 660 WWW site:

<http://lhea-www.gsfc.nasa.gov/~jae/like/>

and EGRET cluster WWW file site:

`$EGRET_DOC/LIKEHTML/`

The web page construction is an on-going task. User help is also available within the Likelihood Analysis software as ascii text scrolled to the output console. I have created graphic files (GIF files) using PC graphic tools (e.g. corel draw) for the WWW pages.

I have performed preliminary software creation in C++ for an advanced version of the Likelihood Analysis Software in anticipation of acceptance of my proposal (see below) submitted in response to NRA 95-ADP-09. This work has been performed at my own initiative and on personal (outside work hours) time on my personal computer at home. If the proposal is not accepted I will continue this project on my own initiative but will complete the project over a much longer time period and with less versatility than originally planned.

III. Data Analysis:

I have continued my analysis of gamma-ray emission from supernova remnants (SNR). A paper titled "EGRET Observations of Radio Bright Supernova Remnants" has been submitted and accepted by the Astrophysical Journal (ApJ) and will appear in the 20-APR-96 volume of ApJ. This on-going work has been extended to include EGRET cycle 4 data and will culminate in a second paper to be submitted to ApJ on all SNRs which are, or are positionally consistent with, 4 sigma (or greater) EGRET gamma-ray sources. A correlation between possible gamma-ray emitting SNRs and SNRs with detections of the OH(1720 Mhz) maser emission line has been recently searched for and found in our data. This will be a major part of my presentation at the next (188th) AAS meeting in Wisconsin (June, 1996). I presented the current status of the SNR research at the 187th AAS meeting in San Antonio, TX, in January, 1996. A cycle 6 proposal requesting a Target of Opportunity (ToO) for a Galactic Supernova event will be submitted in April 1996. This proposal will include a request for non-exclusive data rights to 25 SNRs.

I have continued my collaboration with Dr. Giovanni G. Fazio (CFA) studying the possible gamma-ray emission from Starburst galaxies (e.g. NGC 253; M 82). The work on our cycle 4 data nears completion and upperlimits have been established for 12 Starburst galaxies with a possible weak (~ 2.5 - 3.0 sigma) detection of NGC 253. A cycle 6 proposal requesting a 5 week pointing toward NGC 253, thereby confirming the possible detection, will be submitted in April, 1996. This proposal will include a request for data rights to 10 other Starburst galaxies.

IV. Laboratory Research:

Little work has been done in the laboratory during this time period. Planning is under way for development of microstructure detectors for use as track detectors in a gamma-ray telescope. Work is on-going to model the capacitive coupling of these devices to determine estimates of the power consumption. This modeling has required re-writing existing software (Fastcap software from MIT) to work within our requirements. Additional on-going work includes planning the fast triggering logic, read-out electronics, detector geometry, detector-electronics interface and overall instrument concept.

V. Proposals Submitted:

As PI: NRA 95-ADP-09, "Development of Advanced, Platform Independent, Maximum Likelihood Analysis Software for Astrophysical Data". Requested funding: year 1: \$33,639; year 2: \$25,012; year 3: \$30,346; TOTAL: \$88,997.

As Co-I: NRA 95-OSS-17, "Development of Gas Microstructure Detectors for Gamma-Ray Telescopes". LHEA Gamma-Ray SRT program, PI: Dr. Stanley D. Hunter.

VI. Community Service:

Science Fair Judge: Kenmore Elementary School, 08-Feb.-1996

VII. Refereed Publications:

"AGATE: A high energy gamma-ray telescope using drift chambers," R. Mukherjee, B.L. Dingus, J.A. Esposito, D.L. Bertsch, R. Cuddapah, C.E. Fichtel, R.C. Hartman, S.D. Hunter, and D.J. Thompson, 1996, Space Sci. Rev., Vol. 75, pg. 97

"EGRET Observations of Gamma Rays from Point Sources with Galactic Latitude $+10^\circ < b < +40^\circ$," Nolan, P.L., Bertsch, D.L., Chiang, J., Dingus, B.L., Esposito, J.A., Fichtel, C.E., Fierro, J.M., Hartman, R.C., Hunter, S.D., Kanbach, G., Kniffen, D.A., Lin, Y.C., Mattox, J.R., Mayer-Hasselwander, H.A., Michelson, P.F., von Montigny, C., Mukherjee, R., Schneid, E., Sreekumar, P., Thompson, D.J., and Willis, T., 1996 Mar. 1, ApJ, 459, 100

"The Second EGRET Catalog of High-Energy Gamma-Ray Sources," Thompson, D.J., Bertsch, D.L., Dingus, B.L., Esposito, J.A., Etienne, A., Fichtel, C.E., Friedlander, D.P., Hartman, R.C., Hunter, S.D., Kendig, D.J., Mattox, J. R., McDonald, L.M., von Montigny, C., Mukherjee, R., Ramanamurthy, P.V., Sreekumar, P., Fierro, J.M., Lin, Y.C., Michelson, P.F., Nolan, P.L., Shriver, S.K., Willis, T.D., Kanbach, G., Mayer-Hasselwander, H.A., Merck, M., Radecke, H.D., Kniffen, D.A., Schneid, E.J., 1995 Dec., ApJ, 101, 259-286

"Solar Modulation of Cosmic Electrons," Clem, J. M., Clements, D. P., Esposito, J. A., Evenson, P., Huber, D., L'Heureux, J., Meyer, P., and Constantini, C. 1996, in press

"EGRET Observations of Radio Bright Supernova Remnants," Esposito, J. A., Hunter, S. D., Kanbach, G., Sreekumar, P., 20 April 1996, ApJ, in press

HALF-YEARLY REPORT: Oct. 95 TO Mar 96
Summary of Accomplishments

Reshmi Mukherjee (USRA)
Code 661, NASA/GSFC

1. Analysis of data from the EGRET instrument on the CGRO

I have completed a multiwavelength study of the source PKS 0528+134 from GHz radio to high energy gamma-rays and submitted a paper entitled "EGRET observations of the March 1993 gamma-ray flare from PKS 0528+134" to the Astrophysical Journal. This paper is currently undergoing the review process. I presented the results from this paper at the "Blazar Variability Conference," Miami, Florida, February 4-7, 1996.

I am currently working on a paper that will report on the EGRET observations of blazars seen in Phase 3 and Cycle 4 of CGRO.

I am the principal EGRET contact person for EGRET guest investigator Dr. Marco Tavani of Columbia University for his Phase 3 and Cycle 4 proposals in which he requested observing time for a few unidentified sources. I am responsible for analyzing the EGRET data for these viewing periods.

Other than this I have been responsible for doing the Quicklook analysis of the EGRET data together with another scientist, as well as EGRET viewing period analysis.

2. Laboratory work

I have been involved in the study of gas microstrip detectors for gamma-ray telescopes and I was one of the co-investigators in a proposal for High Energy Astrophysics Supporting Research and Technology Program (NRA 95). I attended the International Workshop on Micro-strip Gas Chambers-Development and Applications, at Institut de Physique Nucleaire, Lyon, France, 29 Nov. to 2 Dec., 1995, to learn more about these detectors.

Reshmi Mukherjee
NASA/GSFC, Code 661, Bldg. 2

9-Apr.-96

Technical report (April 1996)

P.Sreekumar
Activity 5030-12A-39 (EGRET)

A significant part of the last 6 months was utilized to wrap up a long and detailed paper entitled 'EGRET observations of the North Galactic Pole' by Sreekumar et al (Scheduled for publication in Astrophysical Journal, vol. 464 (June 20), 1996. There was considerable rework based on the comments from the referee as well as due to additional corrections in the observational data due to changes in the instrument performance. I was also responsible for determining the energy dependent adjustments to the EGRET spark chamber performance. This was the first time we had introduced energy dependence in this scaling parameter. Additional time was also used to set up the reprocessing as well as cross-checking to make sure the complete EGRET data from the last 5 years was reprocessed using the new correction factors. Some of this work will be written up in a major calibration paper that will be published later this year.

My work on the extragalactic diffuse emission is in progress. With the renormalization of the EGRET data, a lot of reprocessing needs to be carried out with regards to this study as well. Modifications to the Galactic diffuse model to improve inadequacy in the inverse Compton contribution is underway. I have also assisted in the full sky reanalysis of all EGRET detected AGNs (provided automated PERL scripts).

Interaction with collaborators from the Univ. of New Hampshire (who are also Guest Investigators on the CGRO program) in examining the emission from BL Lac object 2155-304. The results are published in ApJ, 454, L93 (1995). Further work on Cen X-3, quasar 0208-512 and an unidentified source is in progress.

Meetings attended:

Invited talk at the Conference on Space based Astronomy, ICTP, Trieste (Nov. 1995).

Technical Report for the period of October 1, 1995 through March 31, 1996

I. SCIENTIFIC RESEARCH

1. Study of the Element Abundances in Solar Atmosphere and Solar Flare Accelerated Particles Using Gamma Ray Spectroscopy

We determined elemental abundances in the solar atmosphere using SMM gamma ray line data. The abundances show a pronounced FIP (first ionization potential) effect. The abundance ratios of the low FIP to high FIP elements (Mg/O, Si/O, Fe/O) are enhanced compared to their photospheric values and are consistent with coronal values. On the other hand, the value of Ne/O (both high FIP elements) is somewhat higher than the coronal value obtained from solar energetic particle data and the generally adopted photospheric value. To avoid an unreasonably high value of Ne/O, a power law energy spectrum of accelerated particles extending down to about 1 MeV/nuc is needed. This implies an approximate equipartition between the total energies carried by accelerated electrons and ions, contrary to the previous belief that the bulk of the flare energy resides in electrons. We also found that the composition of the interacting particles is similar to that of the accelerated particles from impulsive flares, i.e. is enriched in ^3He and heavy elements. Strong enhancement of heavy elements is also required to account for the gamma ray data obtained with the PHEBUS instrument on GRANAT during the extremely intense, behind the limb flare on 1991 June 1. We conclude that, independent of the flare type (impulsive or gradual), gamma rays are produced by particles that are accelerated by the same mechanism that operates in impulsive flares, most likely through gyroresonant wave particle interactions.

2. Pion Decay and Nuclear Line Emissions from the 1991 June 11 Flare

We reexamined the issue of continuous acceleration vs. trapping in the 1991 June 11 flare using a much broader data set than was available previously. We consider updated EGRET spark chamber data, high energy continuum and nuclear line data from EGRET/TASC, and 2.22 MeV line data from COMPTEL covering an extended time period. We find that the data indicate the existence of at least three distinct emission phases characterized by changes in the ion spectrum during transitions from phase to phase. Concerning variability within the phases, we find that the ion spectrum probably remained constant during the second and the third (the most extended - 6h) phases. This implies that the hitherto developed ion transport models are not appropriate for explaining the extended emission observed from the June 11 flare. We propose a different scenario in which the ions are trapped in the low density coronal portions of loops but produce the gamma rays in the denser subcoronal interaction regions; this model of episodal acceleration and subsequent trapping could be consistent with the data.

3. The summary of the charged particle and gamma ray aspects of the Workshop on High Energy Solar Physics held at the Goddard Space Flight Center in August 1995.

The review paper written with Dr. R. Ramaty highlights the most recent and important developments in the study of high energy processes and particle acceleration in solar flares.

II.

Editing and refereeing of the Proceedings of High Energy Solar Physics Workshop held at the Goddard Space Flight Center in August 1995. The book containing over 50 contributed papers will be published by AIP. The other two editors are R. Ramaty and X.-M. Hua.

III. PUBLISHED PAPERS:

"Solar Atmospheric Abundances and Energy Content in Flare Accelerated Ions from Gamma-Ray Spectroscopy", R. Ramaty, N. Mandzhavidze, B. Kozlovsky and R. Murphy, *Ap.J. Lett.*, 445, L193.

"Pion Decay and Nuclear Line Emission from the 1991 June 11 flare", N. Mandzhavidze, R. Ramaty, D. L. Bertsch and E. Schneid, *Proc. of High Energy Solar Physics Workshop*, eds. R. Ramaty, N. Mandzhavidze and X.-M. Hua, (AIP: New York), p. 237.

"Solar Atmospheric Abundances from Gamma-Ray Spectroscopy", R. Ramaty, N. Mandzhavidze and B. Kozlovsky, *Proc. of High Energy Solar Physics Workshop*, eds. R. Ramaty, N. Mandzhavidze and X.-M. Hua, (AIP: New York), p. 184.

"Thin Target Gamma-Ray Line Production During the 1991 June 1 Flare", G. Trottet, C. Barat, R. Ramaty, N. Vilmer, J. P. Dezalay, A. Kuznetsov, N. Mandzhavidze, R. Sunyaev, R. Talon and O. Terekhov, *Proc. of High Energy Solar Physics Workshop*, eds. R. Ramaty, N. Mandzhavidze and X.-M. Hua, (AIP: New York), p. 153.

"Implications of Solar Flare Charged Particle, Gamma-Ray and Neutron Observations: Rapporteur Paper II for the High Energy Solar Physics Workshop", R. Ramaty and N. Mandzhavidze, *Proc. of High Energy Solar Physics Workshop*, eds. R. Ramaty, N. Mandzhavidze and X.-M. Hua, (AIP: New York), p. 533.

TECHNICAL REPORT FOR THE PERIOD OF
1 OCT., 1995 THROUGH 31 MARCH, 1996

Reported by Kai-Wing Chan

Continual efforts are made during this period in the fabrication of x-ray reflectors for the ASTRO-E telescopes. We (the mirror team, including Yang Soong, also of USRA, Peter J. Serlemitsos, of GSFC, a group of 6 technicians, and myself) finalized the production procedures and basic testing as scheduled, before November, 1995. The production started also in November, 1995, as scheduled. The work since then was to do extensive x-ray test with a partial telescope. Unfortunately, some fundamental problems were found soon. The image angular resolution was not as good as we expected, in contrast to the result of preliminary test. In the following few weeks, we did many different experiment in an attempt to find out what was wrong with the fabrication process, or with the tests. It was very unfortunate that we did not find the full solution by the time we went to Japan for the ASTRO-E Science Working Group meeting to report on the status of the telescope. In the meeting held at the Institute of Space and Astronautical Science, Japan, Peter J. Serlemitsos and I reported the problem and partial solution to that, and also on contingency plan and its impact on the schedule. The meeting was held in ISAS on 15-16, March, 1996. Since then, we made fundamental progress on the problem, we have been able to identify the effect of temperature, the effect of vacuum, the effect of spray pattern, and the problem with the x-ray CCD detector saturation. We are able to produce, for a pair of reflector, an angular resolution of 1.1 arc minute in the x-ray at 4 KeV. (The target specification is 1.0 arc minute for the whole telescope.) It seems to us that the problem with us before is largely resolved, even though we still have a long way to go towards the goal. I must also add that Yang Soong, amid serious sickness of his wife, using his time between trips to hospital, home and the laboratory, still contribute significantly to our progress. Among other contributions, he is the one solely responsible for our understanding of the spray pattern, which is believed to be one of the major factor to our problem.

The situation with the project now is that we need to continue to do more experiments to clarify the complicated interplay of the effects mentioned above, to find the best solution towards making a full telescope with 1 arc minute angular resolution, and to incorporate such changes in the operation. We have lost some time in the process, expected to be 5 months or so, and we need to catch up with that. We are in the process of hiring another technician in order to increase the manpower (the technician can be a woman, though.)

Publication:

P.J.Serlemitsos, N.Gehrels, J.Tueller, Y.Soong, K.W.Chan, N.White, H.Kunieda, K.Yamashita, Y.Tawara. "Hard X-ray Balloon Experiment with Super Mirror Telescope" to appear in Proceedings of X-Ray Imaging and Spectroscopy of Cosmic Hot Plasmas Symposium, March 11-14, 1996, Tokyo, Japan.

C.M.Ko, K.W.Chan and G.M.Webb. "Cosmic Ray Modified Shocks with Injection in Hydrodynamic Approach. I. Injection Linear in Thermal Pressure", submitted to Astronomy and Astrophysics.

This is the semi-annual report on progress for Yang Soong at NASA/GSFC. The task number is 5030-14A-39.

In this period, the Astro-E mirror fabrication has started. We are making progress in finalizing the details of the processes. There are two papers, Thin foil X-ray mirrors, an invited paper on Experimental Astronomy written with Peter J. Serlemitsos, and Hard X-ray balloon experiment with super mirror telescope, with the colleagues at Goddard and collaborators at Nagoya University in Japan.

The currently planned delivery of the first of the five telescopes has been set at one year from now. The hard X-ray balloon experiment may be delivered in parallel of the Astro-E program.

This concludes this report. Yang Soong can be reached at 286-6318, or through E-mail Soong@lheavx.gsfc.nasa.gov. Thank you.

March 29, 1996

**Technical report for Grzegorz (Greg) Madejski, working under
USRA contract no. NAS5-30442 to NASA/Goddard
Covers period 10/31/95 - 3/31/96**

- Within the last 6 months, my activities continued to include programmatic work (the X-ray Spectrometer) as well as independent research (X-ray and gamma-ray emission from AGN and BL Lacs).

1. The X-ray Spectrometer

- **BLOCKING FILTERS** : This continues to be my main effort on the ASTRO-E / XRS project. I have been extensively involved in the on-going work on environmental testing of the XRS blocking filters, requiring substantial amount of lab work. The vibratable helium dewar (cryogenic vessel) refurbished by me recently is now operational, and is routinely used for testing of the flight prototype filters. The testing continues. At the moment, the vibration tests show that the filters are not surviving the launch loads, and the detailed investigation is under way.
- **OTHER** : In March 16-17, 1996 I attended the Astro-E Science Working Group
- **PLANS FOR THE NEAR FUTURE**:
 - Revise the UV blocking requirements for the blocking filters (in progress)
 - Prepare the photon noise calculations for "single-filter failure" Astro-E scenarios (in progress)
 - Work on vibration testing of other parts of the XRS

2. Astrophysical Research

- In March 1996, I attended a meeting "X-Ray Imaging and Spectroscopy of Cosmic Hot Plasmas" in Tokyo, Japan, and delivered a paper. I was also a co-author of several other papers presented at that meeting.
- **PROJECTS/PAPERS COMPLETED**:
 - Ground-based data for multi-wavelength campaign to observe OVV blazar 3C279 (Grandi *et al.*) appeared in the *Ap.J.* (Vol. 459, p. 73).
 - Joint ROSAT - Asca - CGRO Egret observations of BL Lac 0235+164 (Madejski, Takahashi, Tashiro, Kubo, Hartman, Kallman, Sikora) appeared in the *Ap.J.* (Vol. 459, p. 156).
 - Radiation drag in AGN relativistic jets (Sikora, Sol, Begelman, Madejski) is in press in

the *Monthly Notices of R.A.S.*

- NGC 4945: The Brightest Seyfert 2 at 100 keV (Done, Madejski, and Smith) was accepted by the *Ap.J.(Letters)* (Vol. 463)
- Asca observations of an X-ray flare in BL Lac Object Mkn 421 (Takahashi, Tashiro, Madejski, Kubo, Kamae, Kataoka, Kii, Makino, Makishima, and Yamasaki) was submitted to the *Ap.J.(Letters)*.
- PROJECTS IN PROGRESS :
- Analysis of the Asca spectrum of Seyfert galaxy ESO-141-G55 (Zycki, Madejski, Czerny) is in progress.
- A paper on Ultra-soft Seyfert 1 galaxy Mkn 478 (w/Andy Fabian, Neil Brandt, Jane Turner, Herman Marshall, and Otani-san) is in progress. Will be presented at the upcoming HEAD meeting in San Diego.
- Hybrid thermal-nonthermal Comptonization models for X-ray emission in AGN (Zdziarski, Lightman, Coppi, Madejski) is nearing completion.
- Spectral constraints on models of BL Lac objects and OVV quasars (Sikora, Begelman, Madejski) is in preparation.
- Data reduction of X-ray spectra of radio-loud Seyfert galaxies (Wozniak, Zdziarski, Smith, Madejski) is being written.
- X-ray studies of BL Lac object 1426+428 (Sambruna, George, Madejski) - the analysis is completed, the paper is being written.
- Multi-wavelength campaign for the blazar 3C279 (Wehrle, Urry, Madejski, ...) - the data have been taken. The first report will be presented at the HEAD meeting at the HEAD meeting in San Diego.
- Multi-wavelength observations of MeV-bright blazar PKS 0528+134 (Collmar, Madejski, Takahashi, ...) - the paper is in progress, will be reported at the HEAD meeting at the HEAD meeting in San Diego.

CONFERENCES ATTENDED / SEMINARS DELIVERED :

- University of California, San Diego (Feb. 20, 1996)
- Cal Tech (Feb. 22, 1996)
- Conference "X-Ray Imaging and Spectroscopy of Cosmic Hot Plasmas" in Tokyo, Japan (March 11-15, 1996)
- Recently accepted proposals (as a PI):
- Asca: Observations of Seyfert 2 galaxy NGC 4945

Technical Report, Michael Loewenstein, 10/1/95-3/31/96

The two papers referred to in the last report – “Measurement of the Elemental Abundances in Four Clusters of Galaxies I. Observations,” (R. F. Mushotzky, M. Loewenstein, K.A. Arnaud, T. Tamura, Y. Fukazawa, K. Matsushita, and I. Hatsukade) and “Measurement of the Elemental Abundances in Four Rich Clusters of Galaxies II. The Initial Mass Function and Mass Loss in Elliptical Galaxies, Enrichment and Energetics in the ICM,” (M. Loewenstein and R. F. Mushotzky) – have been revised and are in press (August 10 issue of the ApJ). A related paper – “The Consistency of Fe Abundances from L and K Emission in Clusters of Galaxies” by U. Hwang, R. F. Mushotzky, M. Loewenstein, T. H. Markert, Y. Fukazawa, and H. Matsumoto – has been completed and is ready for submission.

Work, with K. Arnaud and R. Mushotzky on deriving the dark matter distribution in clusters of galaxies from ASCA data continues. Preliminary results for nearby clusters were presented by Dr. Mushotzky at the March Berkeley-Strasbourg meeting. Preliminary results for more distant clusters, including a comparison with results from gravitational lensing, were presented by myself at the UCLA Dark Matter Symposium in Santa Monica in February and The ASCA Third Anniversary Symposium in Tokyo in March. I will also speak on this subject at the Goddard cosmology seminar on April 24, and more generally on clusters of galaxies at the Center for Astrophysical Sciences seminar at Johns Hopkins University on April 16.

I have completed my analysis of ASCA observations of a sample of low-luminosity elliptical galaxies with optical evidence for micro-quasar activity, and found strong evidence for x-ray nuclear counterparts. A draft of a paper has been completed, and I await feedback from my collaborators (Dr. Mushotzky and Ms. K. Matsushita at the University of Tokyo) before completion and submission. Preliminary results were presented at the AAS meeting in San Antonio in January. This will also be the topic of my presentation at the HEAD meeting in San Diego in May. I gave a talk on abundances in elliptical galaxies at the University of Maryland October conference on “Cosmic Abundances”.

Finally, I was successful on four observing (three ROSAT AO-6, one ASCA AO-4) proposals, refereed three ApJ papers, and am preparing the April 1 seminar for the “Current Perspective in High Energy Astrophysics” course being offered by the University of Maryland Astronomy Department.

This report describes project work completed during the above timeframe, as well as papers submitted, talks given and meetings attended.

MOXE-related items:

MOXE project work: During this time MOXE team member Kevin Black and I began work on documenting the MOXE flight software and commands. I also continued work on the development of software to read raw MOXE data and display it for "quick look" purposes. These codes analyse both the science and the instrument housekeeping data files. While they are still only draft versions at this time, these codes are being used to analyze instrument data to search for bugs in the onboard software.

October 30---November 2. I attended the Spectrum X-Gamma Technical Implementation Committee meeting in Cambridge MA, as the MOXE representative. Issues discussed included instrument team requirements for quick look stations at the Russian ground station, as well as details on the ground contacts for the mission.

February 3---7. I visited members of the MOXE project at Los Alamos National Laboratory (Soren Brandt, Bill Priedhorsky, Cal Moss, Ed Fenimore) to discuss details of the housekeeping data display/analysis for MOXE. We also met with members of the ALEXIS project and were shown their housekeeping displays.

Other science activities:

Papers submitted: During this period, the following papers were submitted for publication, based on my prior and continuing work with HSP data"

"The Ultraviolet Polarization of the Crab Pulsar", J. F. Dolan, P. T. Boyd, J. D. Biggs, et al. (HSP team), submitted to Monthly Notices of the Royal Astronomical Society, March 10, 1996

"Hubble Space Telescope Observations of Active Galactic Nuclei in the Ultraviolet: BL Lac and Q2345+007", J. F. Dolan, P. T. Boyd, J. W. Percival, et al. (HSP team), submitted to ApJ, Feb. 15, 1996.

"Low Dimensional Dynamics in a rapidly oscillating star", G. B. Mindlin, P. T. Boyd, J. L. Caminos, J. Nunez, submitted to Phys. Rev. Lett November 1, 1995

Professional talks and posters:

October 24, 1995: Chaotic oscillations in a rapidly oscillating star?, talk given to Chaos lunch group at GSFC.

October 30, 1005: Pulsars in the Ultraviolet, Harvard/CfA lunchtime seminar at Center for Astrophysics, Cambridge, MA

Jan 14, 1996: Low Dimensional Dynamics in a pulsating star, contributed talk at the AAS meeting in San Antonio, TX

Mar 26, 1996: Low Dimensional Dynamics in a pulsating star, poster for USRA special atrium session, GSFC.

Science Community Service

Scientific reviewer for NASA Extreme UltraViolet Explorer (EUVE) proposal review, December 5-6, 1995

Scientific review of NSF proposal on solar system dynamics, November-December, 1995

Education and Public Outreach

December-January: Rekha Pradham, a student who worked with me during the summer on a JOVE grant, returned to GSFC to complete some of the spectral analysis we had begun. Rekha is a physics major in her junior year at Arkansas.

November 14, 1995: Gave a presentation and participated in a discussion about careers in physics to the Gwynn Park High School Physics Club, Prince George's' County, MD.

March 22, 1996: Co-organized (with Jim Lochner) visit by Gwynn Park H.S. physics students to GSFC, hosted by the OXPOG (OGIP Xray Public Outreach Group)

March 1996—present: participant in the OXPOG public outreach group.

Misc.:

On November 28, 1995, the Chaos lunchtime talk series which I formed celebrated its one year mark with a talk on fractal clouds and Earth's climate given by Bob Cahalan.

i) I have continued my work in theoretical analysis of hot stars, in collaboration with Drs. S. Heap, T. Lanz, and A. de Koter. In particular, we have concentrated on hot massive stars which were recently observed by GHRS of HST. We have submitted a paper to Ap.J. outlining a possible solution of the so-called mass discrepancy for O stars. Another paper, on detailed analysis of several members of the starburst cluster R136a, is almost finished.

ii) In collaboration with Dr. S. Heap we have analyzed recent GHRS observations of the star Beta Pictoris, which is believed to be a typical example of a star with a protoplanetary disk. We have submitted a comprehensive paper to Ap.J.

iii) I have collaborated with Dr. W. Schmutz, ETH Zurich, Switzerland. on models atmospheres of the Of/WN transition stars observed by HST.

iv) I have collaborated with Dr. M. Barstow (Leicester) and his group, and with Dr. J. Holberg (Tucson) on theoretical model atmospheres of hot white dwarfs. Some results are presented in a paper submitted to MNRAS. Recently, we have constructed a self-consistent model atmosphere for a well-known hot DA white dwarf G191 B2B (used as radiometric standard for many UV spectrographs), which explains, for the first time, all the wavelength regions observed (IR, optical, UV, EUV, and soft X-ray). The results are presented in a paper submitted a paper to Ap.J. Letters.

v) I have continued a collaboration with the group of Dr. E. Sion (Villanova University) on HST spectra of cataclysmic variables. We have submitted a paper to A.J. on the HST quiescence spectra of VW Hydri, and another paper is almost ready to be submitted to Ap.J. Letters.

vi) I have continued collaborating with Dr. Knox Long (STScI) on analysing UV observations of cataclysmic variable systems. A paper on interpretation of HUT observations of VW Hydri was submitted to Ap.J.

vii) I have continued my collaboration with Prof. M. Plavec (UCLA) on model atmospheres and accretion disks in cataclysmic variables and symbiotic stars.

viii) I have worked Dr. Al Linnell (University of Washington) on a further development of our spectrum synthesis code for binary stars. We have modified the program to include an accretion disk. The results were presented at the AAS meeting in San Antonio, and a paper submitted to Ap.J.

Trips accomplished:

i) October 2 - 7, University of Wisconsin, Madison
Giving a colloquium and two special lectures for graduate students; collaboration with Dr. J. Cassinelli and his group on models atmospheres for B stars, and with Dr. J. Bjorkman and K. Wood on radiative transfer in axisymmetric, 2-D stellar winds and disks.

ii) October 17 -29, ETH Zurich, Switzerland.

Giving a colloquium; collaboration with Dr. W. Schmutz on models atmospheres of the Of/WN transition stars observed by HST.

iii) November 21 - 22, Villanova University, PA.

Collaboration with Drs E. Sion and M. Huang on analysis of HST observations of cataclysmic variables.

iv) December 6 - 13, UCLA, Los Angeles.

Collaboration with Prof. M. Plavec on model atmospheres and accretions disks in cataclysmic variables and symbiotic stars, and with Dr. M. Malkan on model atmospheres for accretion disks in active galactic nuclei.

v) March 2 - 9, University of Washington, Seattle.

Giving a colloquium; collaboration with Dr. A. Linnell on a spectrum synthesis program, and with Dr. P. Szkody and her group on analysing UV observations of cataclysmic variables.

vi) March 24 - 27, Caltech, Pasadena.

LTSA peer review panel; collaboration with Dr. M. Kerkwijk on model atmospheres for white dwarfs found in binary system with pulsars.

Papers submitted:

Hubeny, I., Lanz, T., 1996,

''Fully Line-Blanketed NLTE Model Atmospheres for Hot Hydrogen-Deficient Stars'', in Hydrogen-Deficient Stars, ed. by C.S. Jeffery and U. Heber (in press)

Lanz, T., Hubeny, I., de Koter A., 1995,

''Atomic Data for non-LTE Model Atmospheres'' in Proceedings 5th Internat. Coll. on Atomic Spectra, Physica Scripta (in press).

Lanz, T., de Koter, A., Hubeny, I., Heap, S.R., 1996,

''Towards Resolving the 'Mass Discrepancy' in O-type Stars'' Astrophys. J. 465 (in press).

Barstow, M.A. Holberg, J.B., Hubeny, I., Lanz, T., Bruhweiler, F.C., 1996,

''Solving the mystery of the heavy element opacity in the DA white dwarf GD394'', Mon. Not. Roy. Astron. Soc., (in press)

Long, K.S., Blair, W.P., Hubeny, I., Raymond, J.C., 1996,

''Observations of the Dwarf Nova VW Hydri in Quiescence with the Hopkins Ultraviolet Telescope'', Astrophys. J. (in press).

Linnell, A.P., Hubeny, I., Lacy, C.H., 1996,

''A Spectrum Synthesis and New Light Synthesis Study of EE Pegasi'' Bull. Amer. Astron. Soc. 27, 1372.

Wade, R.A., Hubeny, I., 1996,

''Accretion Disk Models for VOYAGER, HUT, and FUSE Far-UV Spectra'' Bull. Amer. Astron. Soc. 27, 1397.

Stecher, T.P., Landsman, W., Crotts, A.P.S., Whitney, J., O'Connell, R.W.,

Lanz, T., Hubeny, I., Sweigart, A., 1996,

''Support for the Primordial Helium Abundance Derived from Observation of Globular Clusters'',

Linnell, A.P., Hubeny, I., 1996,

''A Spectrum Synthesis and Light Synthesis Program for Binary Stars with Optically Thick Accretion Disks'', Astrophys. J. (submitted).

Huang, M., Sion, E.M., Hubeny, I., Cheng, F.H., Szkody, P., 1996,

''Accretion Disk during Quiescence of VW Hydri'', Astron. J. (in press).

Hubeny, I., Heap, S.R., 1996,

''HST/GHRS Observations of the β Pictoris system: Tracking Comet-Like Objects Orbiting the Star'', Astrophys. J. (in press).

Lanz, T., Barstow, M.A. Hubeny, I., Holberg, J.B., 1996,

''A Self-Consistent Optical, Ultraviolet, and Extreme Ultraviolet Model for the Spectrum of a Hot DA White Dwarf G191-B2B'', Astrophys. J. Letters (submitted).

My plans for the next six months include:

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- i) I will continue my work in theoretical analysis of hot stars, in collaboration with Drs. S. Heap, T. Lanz, and A. de Koter. Besides general methodological development, we will work on a paper on the hot subdwarf BD +75 325, on the central star of NGC 6826 and on individual stars in the cluster R136a.
 - ii) I will continue my collaboration with Dr. M. Barstow (Leicester) and his group on theoretical model atmospheres of hot white dwarfs.
 - iii) I will continued a collaboration with the group of Dr. E. Sion (Villanova University); and Dr. K. Long (STScI) on HST and HUT spectra of cataclysmic variables.
 - iv) I will work on theretical models for accretion disks in active galactic nuclei, which were observed by GHRS, and are going to be observed by STIS.
 - v) I will prepare prepare a series of lectures on ''Theory of Stellar Atmospheres'' for the summer school in Brussels, Belgium.

Travel plans:

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- i) April 22-30, University of Leicester, and Univeristy College London, UK. Collaboration with the group of Dr. M.A. Barstow (Leicester), and with Drs. K. Smith and I. Howarth (UCL); giving a colloquium at UCL.
 - ii) May 21-23, Univeristy of Oslo, Norway. Giving a colloquium; collaboration with Dr. M. Carlsson on radiative transfer with partial frequency redistribution.
 - iii) September 10 - 20, Brussels, Belgium. Attending European Summer School "Stellar Atmospheres: Theory and Observations"; giving a series of lectures on "Theory of Stellar Atmospheres."

TECHNICAL REPORT
(1 October 1995 - 31 March 1996)

Name: Paul Barrett
Activity: 5030-20A-39

I. SUMMARY

A. Task Work

1. COSSC Bibliography

During February - March 1996, much effort has been given to the COSSC bibliography in anticipation of the NASA Senior Review in June 1996. Work by Dora Serlemitsos, Sandy Barnes, and myself has made for much progress. The bibliography is nearly complete dating back to January 1991. We anticipate bringing the bibliography completely up-to-date with the next few weeks. When this is accomplished, verifying the records we currently have and adding news one, should not require a large amount of time.

2. COMPASS (COMPTel Analysis Software System)

In the previous technical report, it was noted that the programmer associated with COMPASS resigned. Since that date, a new programmer has been hired and been assigned part time to the COMPASS maintenance effort. During the period 1996 January-March, a review of COMPASS was made to check the integrity of the database records and corresponding files. Missing files were requested from UNH or from the COSSC archive and then copied from tape.

The COMPTel All-Sky Maps were acquired from the CompTel team and have been added to 'Skyview' and will soon be added to the COSSC homepage. In addition permission for use of the MEMSYS routine (Maximum Entropy algorithm) was finally obtained and the subroutine was install in COMPASS.

Efforts are underway to acquire the DRE-, DRG-, and DRX-type EGRET data from the CompTel team and to create EVP-type EGRET data for use in COMPASS. This will allow COMPTel and EGRET data to be analyzed jointly and consistently, with the expectation of providing new and important results not possible by analyzing the data independently.

Other proposed COMPASS projects are to create an automated 'pipeline' for archiving the COMPTel data in FITS format and to move the COMPASS software from the node 'cosmic.gsfc.nasa.gov' to 'compass.gsfc.nasa.gov' and to upgrade the two nodes with a new operating system and an additional processor.

3. Remote Proposal Submission (RPS)

As Cycle 6 of the CGRO NRA approaches on 1996 April 19, I have given more attention to RPS than in the previous report period. The system was made available to the public in late January, though little use of it has been made to date. During the past year the system has been made less mission dependent and robust, so we expect no major problems and only one or two minor bugs during the proposal cycle. It appears that most of the proposals will arrive during the two weeks prior to the proposal deadline. The help that we have provided to users so far has been solely due to user problems, such as not reading (we believe) the copious documentation or not taking the time to investigate the problem completely.

4. Argus (was Multi-mission Interactive Proposal System, MIPS)

As noted in the previous report, most of the effort for this project was spent at meetings to discussion the design and implementation of a Web version of this software. I prepared and delivered the cycle 5 timeline to the database programmers. Efforts are continuing.

B. Research

1. Soft X-Ray Survey of CVs Using Archival ROSAT data.

Some effort has been periodically spent on this project coordinating follow-up ground-based optical observations with collaborators. Efforts will continue until most of the sources in the Ultra-Soft Source list has been identified. A paper on some white dwarfs discovered during the survey is in preparation. A proposal for observing time at the Nordic Optical Telescope with myself as a Co-I was accepted by the Time Allocation Committee. The time was awarded for late February 1996.

2. Compton/COMPTEL Data

Some additional progress has been made on analyzing the CompTel data. Work as has been slowed due to pro-grammatic activities and other scientific research projects.

3. XTE Proposal.

Two XTE proposals were submitted to and accepted by the XTE Peer Review Panel. I was PI on the first proposal entitled "X-Ray Oscillations in AM Her Binaries" and was co-I on the second proposal entitled "XTE Observations of the Precessing Disk Cataclysmic Variable TV Col". Some effort was spent during August 1995 in scheduling simultaneous ground-based observations which in the end proved futile as the mission launch was delayed by two months.

4. CTIO Proposal

I was PI on a proposal submitted to the Cerro Tololo Inter-American Observatory (CTIO) in Chile to make simultaneous optical and XTE observations of the magnetic Cataclysmic Variable V834 Cen in 1996 March. This proposal was accepted. Another proposal has been submitted for time in October to observe EF Eri as part of the same XTE proposal.

5. Space Telescope Proposal

I was co-I on a proposal submitted to the Space Telescope Science Institute (STScI) in Chile to make simultaneous optical and XTE observations of the magnetic Cataclysmic Variables, EF Eri and V834 Cen. This proposal was not accepted.

6. Electronic Proposal Submission (EPS) software

Some progress was made on a prototype for Electronic Proposal Submission software. This project is designed to replace the current RPS software with a simpler and more robust design for both programmers and users.

7. EUVE Proposal Review

In 1995 December, I was a reviewer for the EUVE proposal review.

8. Paper Accepted by PASP

A paper entitled "Distances to Cataclysmic Variables Using Linear Polarimetry" was accepted by the Pub. of the Astronomical Society of the Pacific and is to be published in the 1996 May issue.

9. Astrophysics Data Program (ADP) Proposal

An ADP proposal was submitted to NASA. The proposal is to search for ROSAT sources not associated with optical sources in the Digital Sky Survey. No result from the Proposal Review has been received.

10. CGRO Cycle 6 Proposal

I assisted in the preparation of a CGRO Cycle 6 Proposal. Eric Schlegel is PI and Chris Shrader, Daryl Macomb, and I are co-Is.

II. FUTURE WORK AND RESEARCH

A. Task Work

1. Compton GRO Publication Database

Continue enhancing the GRO publication database by adding new publications.

2. COMPASS Software Administration

Work will continue on administration, maintenance, and improvements to the COMPASS software here at Goddard. Will work on proposal to upgrade software and hardware of both Sun SPARCstation 20s.

3. RPS and MIPS Meetings.

Attendance at RPS and MIPS meetings will continue.

4. Electronic Proposal Submission (EPS) software

Continue implementing the EPS prototype when time allows.

B. Research

1. Continue working on ROSAT Survey of Cataclysmic Variables.

2. Continue working on COMPTEL data analysis.

3. Continue preparation of XTE observations.

4. Continue working on identification of ROSAT Ultra-soft Sources.

III. MEETINGS AND SYMPOSIA ATTENDED

1. Attended the COMPTEL Team Meeting at UNH in 1995 October 10-13. Gave a presentation about the status of COMPASS at the COSSC.

2. Attended the Astronomical Data Analysis and Software Systems (ADASS) IV Meeting in Tucson, AZ in 1995 October 23-25. Presented a paper.

**Contract Technical Report - October 1995 through March 1996
Dr. Jerry T. Bonnell**

Activity: 5030-20A-39 Compton GRO Science Support Center LHEA/GSFC

Performed timing and spectroscopic studies of gamma-ray bursts using BATSE data.

Served as guest investigator consultant for BATSE/GRO data and software.

Contributed to development of GLAST simulation using GISMO software package.

Co-edited and co-authored Astronomy Picture of the Day World Wide Web Site.

Organizer for "Scale of the Universe" debate (April 21, 1996) co-sponsored by Smithsonian Institution.

Contributed to Compton GRO exhibit which opened at the National Air and Space Museum in February 1996.

Publications:

"Diamond Jubilee Debate"

Jerry T. Bonnell (USRA/GSFC), Robert J. Nemiroff (GMU/GSFC), Carlo J. Graziani (NRC/GSFC) , Submitted to Hunstville Burst Workshop Proc.

"A Brief History of the Discovery of Cosmic Gamma-Ray Bursts"

J.T. Bonnell, R.W. Klebesadel, Submitted to Hunstville Burst Workshop Proc.

"Brightness-Independent Measurements of GRB Durations"

J.T. Bonnell, J.P. Norris, R.J. Nemiroff, and J.D. Scargle Submitted to Hunstville Burst Workshop Proc.

"Time Histories and Spectra of Terrestrial Gamma Flashes"

Robert J. Nemiroff (GMU/GSFC), Jerry T. Bonnell (USRA/GSFC) submitted to Geophysical Journal

Activity Report for
W.T. Bridgman
Period Ending March 1996

In project support accomplishments, the IGORE response matrix generator is now available through COSSC as is the OSSE command state database. We have a new IGORE installation at Rice University. Web pages for the OSSE high level archive went on-line in February, accessible through

<http://cosscc.gsfc.nasa.gov/cosscc/osse/hilev/hilev.html>

XSPEC formatted spectral files are available in the high-level archive. I have written some Perl scripts to monitor activity on these pages.

There have been numerous GI support activities. We are moving into a mode where high-level products on public data not currently in the high-level archive are run on a 'per-request' basis for the GI. This service is for official as well as public GIs.

Several OSSE time-slots were open in the Cycle 5 viewing plan so I coordinated a 'mini-proposal' cycle for suggested targets. I tried to get several small colleges where I have contacts involved, but only one graduate student in Sweden actually applied. Four proposals were submitted for three time slots. The winners turned out to be seasoned CGRO proposers.

In research, my cross-spectral screening technique works well but the amount of data in the OSSE timing database in the appropriate format is limited. I have proposed for CGRO Cycle 6 an additional Cygnus X-1 observation to collect data in the appropriate format. I am also submitting a CGRO proposal with Eric Grove of NRL to conduct pulsar searches in BATSE data. I am also working with Chuck Dermer and Jeffrey Skibo of NRL to develop my reflection timing signatures models. Some of this has been incorporated into the Cygnus X-1 proposal. I will be presenting the results of my new screening method and some preliminary reflection modeling results at the HEAD 96 meeting.

In the area of outreach activities, I was recently awarded an IDEA grant from STSci to work with PG County public school teachers training them in teaching astronomy. At the end of March I made a presentation at the Greenbelt Astronomers Club on the "The Care & Feeding of Black Holes". I plan to repeat this presentation and conduct one on "Astronomy on the Internet" on Astronomy Day, April 20, at the Owen's Science Center on Greenbelt Road.

Report for Dr. Mark H. Finger

October 1 1995 - March 31, 1996:

In spite of the furloughs considerable progress has been made on BATSE archival data delivery in the last half year. However deliveries are not yet up to schedule (one year after observation) in all areas. The first ever deliveries of occultation data to the GROSSC occurred in October, and steady progress has been made since then with 700 days data delivered so far. Delivery of Burst IBDB's are on schedule, as are deliveries of pulsar low level data, and pulsar lightcurve files. An initial delivery of pulsar histories was made, with the remaining histories expected to be delivered in April. Delivery of the background datatypes CONT and DISCLA has been delayed because of a problem discovered in the associated energy calibrations. Code has now been completed to correct the files, and delivery is expected to be brought up to schedule soon.

In December a new and quite unusual transient source was discovered near the galactic center. Initially only bursts of hard x-rays were seen with no persistent flux. The nature of the object was unclear, and the subject of much of speculation. Then persistent emission from a transient in the same region was seen. It was suspected that this was from the same source, but the galactic center is a very active region, and the position errors on the burst source and persistent transient were large, so the association could have been coincidental. In early January I discovered pulsations in the fft monitor, which I showed were from the persistent transient, demonstrating that it was a pulsar. The burst were then shown to contain pulses at the same frequency as the pulsar, shown they were one and the same source. This makes the source and extremely interesting object, one which shows both bursting and pulsing behavior, something that has never been observed in a single neutron star. By tracking the pulsar's frequency I then discovered an orbital doppler signature, which lead to the determination of it's binary orbit, and the conclusion the pulsar was orbited by a low mass optical companion.

Publications:

"Discovery of Pulsations from a bursting hard X-ray source"

Mark H. Finger, Danny T. Koh, Robert W. Nelson, Thomas A. Prince, Brian A. Vaughan, and Robert B. Wilson, accepted for publication as a letter to Nature.

"Evidence for neutron star formation from accretion induced collapse of a white dwarf"

J. van Paradijs, E.P.J. van den Heuvel, C. Kouveliotou, G. J. Fishman, M. H. Finger and W. H. G. Lewin, submitted to Nature, 5 February 1996.

"Quasi-Periodic Oscillations During a Giant Outburst of A0535+262"

M. H. Finger, R. B. Wilson, and B. A. Harmon, Astrophysical Journal, 459, 288-297, 1996 March 1.

"Observations of 4U 1700-27 with BATSE"

B. C. Rubin, M. H. Finger, B. A. Harmon, W. S. Paciesas, G. J. Fishman, R. B. Wilson, C. A. Wilson, M. N. Brock, M. S. Briggs, G. N. Pendleton, L. R. Cominsky and M. S. Roberts, *Astrophysical Journal*, 459, 259-270, 1996 March 1.

"Timescale Invariance of Rapid X-ray Variability of the Black Hole Candidate GRO J1719-24"

F. van der Hooft, C. Kouveliotou, J. van Paradijs, B. C. Rubin, D. J. Crary, M. H. Finger, B. A. Harmon, M. van der Klis, W. H. G. Lewin, J. P. Norris, and G. J. Fishman, *Astrophysical Journal*, 458: L75-78, 1996 February 20.

"Useful Classes of Redundant Arrays for Imaging Applications"

Mark H. Finger and Thomas A. Prince, in *Imaging in High Energy Astronomy*, L. Bassani and G. di Cocco (eds.), Kluwer Academic Publishers, 1995, p 221-226.

"Photon Statistics of Point Source Correlation Images in Coded Aperture Imaging"

Mark H. Finger and Thomas A. Prince, in *Imaging in High Energy Astronomy*, L. Bassani and G. di Cocco (eds.), Kluwer Academic Publishers, 1995, p 373-378.

"GRO J1744-28"

M. H. Finger, R. B. Wilson, Jan van Paradijs IAU Circular 6286, 12 Jan. 1996.

"GRO J1744-28"

M. H. Finger, R. B. Wilson, B. A. Harmon, K. Hagedon, and T. A. Prince, IAU Circular 6285, 10 Jan. 1996.

"4U 0115+634"

M. H. Finger, M. Scott, K. Hagedon, R. B. Wilson, C. A. Wilson, M. Stollberg, W. S. Paciesas, T. A. Prince and B. Vaughan IAU Circular 6266, 22 Nov. 1995.

Plans for the April - October 1996:

I will be PI on the CGRO proposal for the BATSE pulsar team/Caltech program of x-ray binary observations. I will submit guest investigation proposals on A0535+262 for both the Compton Observatory (cycle 6) and for XTE.

In April I will attend the HEAD meeting in San Diego where I will present a paper on our pulsed observations of GRO J1744-28.

In July I will attend the COSPAR meeting in Birmingham, England where I will present an invited talk on QPO's in transient x-ray pulsars.

I am currently working on a paper with Brad Rubin on the long period pulsar 4u 1538-52, which I expect we will finish in the next few months. I then plan to work on a long term study of Cen X-3.

Daryl Macomb
Oct. - March 1996

My support work consisted of the following: Continued to act as the EGRET support person at the CGRO Science Support Center. This has involved supplying GI's with software and data, keeping them informed of timeline changes, and working on documentation. In addition, I have been working on a brochure on gamma-ray astronomy for public outreach.

In terms of research; I submitted a paper to Astronomy and Astrophysics based upon a poster paper given at last years Compton Symposium. The paper is accepted for publication in Astronomy and Astrophysics and is entitled "Extending the Spectral Coverage of Unidentified Galactic Plane Gamma-Ray Sources". This paper provides a joint EGRET/Comptel analysis of various 100 MeV gamma-ray sources. I also continued to work on several projects including a general gamma-ray catalog. I submitted an abstract to the HEAD meeting in San Diego and am a co-author on two other HEAD meeting papers.

**Bi-Annual Progress Report for
Chris R. Shrader, USRA/CGRO-SSC
(Activities for October 1, 1995 - March 31, 1996)**

CGRO Guest Investigator Program: The CGRO Cycle-6 NRA and appendices were edited, proof read, and prepared for distribution with the cognizance of the Program Scientist. Some significant changes to the program, including the modified use of the EGRET instrument, and some new policy issues required major changes to certain portions of the NRA. For example, the budget submission is now separate from the initial proposal submission -a plan to implement this was devised. Also, this was the first CGRO NRA to be published through Goddard - there was minimal involvement by NASA HQ due in large part to the drastic staff reductions there. There were significant delays due to the two government furloughs and the snow closings. This resulted in numerous schedule modifications. The NRA was then posted electronically on GRO-SSC and HEASARC on-line bulletin boards, and distributed upon request to interested Guest Investigators.

A plan was devised to handle the Cycle-6 budget submission and evaluation process, which is now separate from the initial proposal submission. Requirements for modifications to the HEASARC "RPS" (Remote Proposal Submission) software were delivered in a timely manner to the HEASARC programming staff for implementation. Testing, and feedback was then provided.

Routine Guest Investigator inquiries, too numerous to list, were handled. Subjects included instrumentation technical details, program policies and procedures and the proposal evaluation process.

The GRONEWS bulletin board facility and the CGRO-SSC World Web site were updated to include, for example, targeting summaries for the Cycle-5 peer-review results, program descriptions and targeting information. Additionally, the CGRO monthly status reports (e-mail) Status Reports were prepared and distributed.

Project Support: Final efforts to complete a CGRO exhibit at the National Air an Space Museum (NASM) were carried out. This involved numerous planning meetings at NASM, extensive editing of written materials, and providing of graphics materials to NASM. Additionally, the contract to produce the accompanying video "Viewing Our Violent Universe: The Compton Gamma Ray Observatory" was managed, and extensive technical consultation provided to the producer.

Extensive support to the Project Scientist for the formal opening of the exhibit, in conjunction with a celebration of the 5th year launch anniversary of CGRO was provided. The event occurred on March 20, 1996 at NASM.

Various statistics regarding the CGRO Guest Investigator program were supplied upon request to NASA Headquarters. Supervision of the SSC GI Program database continued.

Participation, as co-chair, on the local organizing committee for the Fourth Compton Symposium was an additional task during the reporting period. A draft "1st announcement" was prepared and delivered to the CGRO scientists at the Naval Research Laboratory, which will host the symposium in April of 1997.

CGRO-SSC Group Leader Activities: Various internal CGRO-SSC organizational meetings were held to coordinate the various ongoing activities.

Planning to offset the impact of forthcoming staffing changes at the CGRO-SSC are ongoing. A job description for a potential new BATSE support scientist position has been conceptualized and drafted.

Scientific Research: A paper which will present a comprehensive compilation of historical X-ray Novae light curves was completed (along with Dr. Wan Chen, also of USRA) and submitted to the Astrophysical Journal. Many aspects of the paper were presented by the authors at the recent Aspen Workshop on Astrophysics during January of 1996.

Three articles presenting results on CGRO data analysis, collectively utilizing three of the four instruments, were submitted, and ultimately accepted for publication in Astronomy and Astrophysics.

A paper describing recent results on relativistic jets in galactic X-ray novae, and their possible relationship to extragalactic radio sources, was prepared and presented at a workshop on "Blazar Variability".

TECHNICAL REPORT
DR. J. GREGORY STACY

INSTRUMENT SPECIALIST GI-SUPPORT PROGRAM

MEETINGS AND PRESENTATIONS:

Greg participates in regular meetings at UNH related to instrument operation and performance, COMPASS software development, and the scientific analysis of COMPTEL data. He also maintains regular contact with colleagues at the SSC and at the GSFC. Greg attended and participated in two COMPTEL team meetings, one from 10/10-13/95 at UNH, and the other from 2/26 to 3/3/96 at SRON-Utrecht, in the Netherlands. At both, he reported on the status of GI-related activities to the COMPTEL collaboration. On 10/7/95 Greg presented a poster on the "Imaging Compton Telescope (COMPTEL) aboard the Compton GRO" at the Fall Meeting of the New England Section of the APS at Bowdoin College. On 12/4/95, Greg presented a colloquium on "Recent Results and Highlights from the Imaging Compton Telescope (COMPTEL) on the Compton GRO" to the Astronomy Department at Boston University. Greg continues to prepare the COMPTEL contribution to the CGRO monthly science report, on behalf of the collaboration.

GI CONTACTS AND VISITS:

Greg continues to have regular contact with COMPTEL Guest Investigators, as do other COMPTEL team members at UNH and in Europe. A recent list of GI contacts and/or visits, to the various COMPTEL sites, includes the following. To UNH: J. Schachter (CfA), E. Frederick (N.E. Science Ctr), C. Shrader (GSFC), D. Macomb (GSFC), T. Vestrand (UNH), D. Meredith (UNH), H. de Brunner (Bern), A. MacKinnon and K. MacPherson (Glasgow), B. McNamara (NMSU), UC/Riverside group. To MPE: M. Maisack (Tuebingen), A. Iyudin (Moscow), W. Chen (GSFC), P. van Ballmoos (Toulouse). To ESA/ESTEC: R. Buccheri (Palermo), A. Carraminana (Mexico), L. Hanlon (Dublin), R. Much (ESA). To SRON/Utrecht: C. Dupraz (Meudon). As usual, Greg fielded a number of queries from GIs related to the preparation of CGRO Cycle 6 proposals. He is also in regular contact with W. Collmar, his counterpart with the COMPTEL group at MPE, regarding GI issues.

DATA ARCHIVE AND DATA ACCESS FOR GIS:

Through the efforts of J. Labonte of UNH and P. Barrett of the COSSC, steady progress has continued with the installation and validation of COMPASS at the SSC. With R. Freuder and M. McConnell of UNH, Greg has assured that all low-level and first high-level COMPTEL data products, including the first release of all-sky maps, and maximum-likelihood skymaps by viewing period, through Phase 3 of the CGRO mission have been released to the CGRO data archive.

Greg is also coordinating with P. Barrett of the COSSC the development of a 2-CD CD-ROM to contain COMPTEL data and documentation, intended for public distribution. Greg has developed, and continues to maintain general COMPTEL informational pages on the World Wide Web, and, with Tom Milliman of UNH, is maintaining an anonymous ftp area on the GI workstation at UNH for the electronic distribution of COMPTEL team publications. The COMPTEL electronic publications archive currently contains 60+ collaboration papers. He is currently developing a searchable publications database of all team publications, to be made available on the WWW.

COMPUTER HARDWARE AND SOFTWARE FOR GI SUPPORT:

With T. Milliman of UNH Greg continues to maintain the GI workstation area at UNH. Greg maintains the COMPTEL "exposure-calculator" tool and several other software utilities for GI and general use. New software utilities and data browse tools will also likely be developed for the COMPTEL CD-ROM.

SCIENTIFIC RESEARCH:

Greg submitted two papers as primary author to the proceedings volume of last year's Compton Symposium in Munich: one relates to a Monte Carlo simulation study of the COMPTEL response, the other reports on a multiwavelength campaign to study the gamma-ray blazar PKS 0208-512. Also from the Munich meeting, he is co-author on several papers related to COMPTEL team results on the Galactic diffuse emission and gamma-ray AGN. He is also co-author on a paper related to a CGRO GI project, with T. Vestrand of UNH, on a GRO survey of flat-spectrum radio sources toward the South Galactic Pole.

Under this ongoing CGRO guest investigation with T. Vestrand, Greg is presently co-coordinating an international multiwavelength campaign to study two gamma-ray AGN. First results on the BL Lac object PKS 2155-304 appeared as a letter in the *Astrophysical Journal* (Vestrand, Stacy, and Sreekumar) in December 1995. A report on possible flaring activity in the gamma-ray blazar PKS 208-512 was issued as an IAU Circular 6348 (Vestrand, Stacy, Mukherjee, and Sreekumar) in March 1996. An abstract has been submitted to present further results on PKS 0208-512 at the upcoming meeting of the High Energy Astrophysics Division of the AAS in San Diego in April/May 1996.

Within the COMPTEL team, Greg maintains his interest in studies related to the Galactic diffuse emission, and continues his work on a general AGN survey with COMPTEL data.

Greg is PI on accepted and funded ROSAT AO6 and ASCA AO4 observing proposals related to x-ray observations of gamma-ray AGN. He is Co-I on an accepted XTE proposal to observe the BL Lac object PKS 2155-304. He is Co-I on a VSOP proposal to observe selected gamma AGN with space VLBI. He is PI of an ongoing project to observe a sample of gamma-ray AGN with the CMVA (3-mm VLBI); first CMVA observations were carried out in December 1995, and a follow-up proposal was submitted in March 1996. He is also PI on a continuing project to monitor gamma-ray AGN at millimeter wavelengths with the Haystack radio telescope in Westford, MA; observations were carried out in March 1996, with follow-up scheduled for April 1996.

Greg continues his work with collaborators on an ADP project to search the COBE DMR database for transient signals at microwave wavelengths associated with cosmic gamma-ray bursts. He visited Greenbelt, MD in October 1995 to work with collaborator P.D. Jackson of Hughes/STX on this program, and later in October presented a poster of results at the Third Gamma-ray Burst Workshop in Huntsville, Alabama, for which a proceedings paper is currently in press. Further results were presented by P.D. Jackson et al. at the 187th meeting of the AAS in San Antonio, Texas, in January 1996. Greg is Co-I on a follow-up ADP proposal to continue and extend this project, submitted in February 1996.

EDUCATIONAL AND "COMMUNITY-OUTREACH" ACTIVITIES:

As part of an ongoing graduate seminar series, Greg presented a colloquium in January 1996 within the EOS institute at UNH, on recent advances in the study of star formation.

Greg continues his activities as Co-I on two NASA/IDEA projects. One is a collaborative effort involving monthly meetings with the staff of the Christa McAuliffe Planetarium in Concord, NH and local teachers, to work with selected groups of high-school students to disseminate the latest results of space research to public audiences. Another program, based at the NE Science Center in Worcester, Massachusetts, is an educational outreach project directed toward middle-school teachers and their students.

On 12/21/95, with A. Connors of UNH, Greg gave a talk on gamma-ray astronomy to Mr. Broad's physics classes at the Timberlane Regional HS in Plaistow, NH. On 3/12/96 Greg gave a slide-show presentation and talked with Mrs. Heise's 5th-grade class on space science topics at the Oyster River Middle School in Durham, NH. He has also agreed to talk to group of high-school students in the Math and Marine Science (M&M) program run by UNH Cooperative Extension, and he will once again be team-teaching (with J. Macri of UNH) a one-week Elderhostel course on current topics in high-energy astrophysics during the coming summer.

Finally, for the record, it was a landmark year for snow in New Hampshire: 100+ inches, highest total in over a century. It was fun for awhile, but we're all tired of it now, and impatiently waiting for spring to really and truly arrive.

- XTE

XTE was launched on 1995 December 30th. Since that time the XTE SOF has been extremely bust. First with the InOrbit Check-out phase, then transitioning to normal operations.

The "normal" operations were hampered by, first, problems with the All Sky Monitor and, recently, with break down in two of the five Proportional Counter Units. The PCU problems may now be alleviated however, the problems have dramatically affected our operations as we have to keep the PCUs at a reasonable operating temperature to avoid further detector break down. Since the goal of XTE is to look anywhere in the sky (excluding a small region around the Sun) we have to balance many competing wishes.

Despite these problems, XTE is proving to be a productive exciting mission. The occurrence of the unique transient pulsating, bursting source GRO1744-28 was almost custom designed for XTE with its wealth of fascinating timing behavior. In addition, a new phenomenon, kHz QPOs have been discovered from other objects through XTE's very high time resolution and large collecting area.

The XTE SOF has performed well in responding to the satellite problems, and also in responding to the many requested Target of Opportunity Observations.

- I continue to be heavily involved in ASCA data analysis, including some data obtained in coordination with XTE and various projects are nearing completion, in progress, and just being started...

- The Ginga reformatting project continues to progress with Penn State University programmer Scott Koch carrying out most of the implementation of this with my guidance.

- Paper Submitted & Published:

"Transient X-ray sources, luminosity gaps, and neutron star densities", R.H.D. Corbet, 1996, *Astrophys. J.*, 457, L31.

- Papers Submitted:

"SETI at X-ray energies; parasitic searches from astrophysical observations", R.H.D. Corbet, 1996, *JBIS*, in press.

"Orbital decay, spin down, and pulse-phase resolved spectroscopy of LMC X-4 from Ginga and ROSAT observations", J.W. Woo, G.W. Clark, A.M. Levine, R.H.D. Corbet, & F. Nagase, 1996, *Astrophys. J.*, in press.

- Conference Papers etc.

"A low amplitude X-ray and optical outburst from the periodic transient A0538-66; accretion onto a magnetosphere?", R. Corbet, A. Smale, P. Charles & K. Southwell, "X-ray Imaging and Spectroscopy of Cosmic Hot Plasmas", Tokyo, Japan, March 1996.

"4U1755-33", M.S.E. Roberts, P.F. Michelson, L.R. Cominsky, F.E. Marshall, R.H.D. Corbet & E.A. Smith, 1996. *IAUC* 6302.

"Transient X-ray sources and luminosity gaps", R.H.D. Corbet, 1996, *BAAS*, 27, 1436.

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